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Smolt Condition and Timing of Arrival at Lower Granite Reservoir

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STATE OF IDAHO

DEPARTMENT OF FISH AND GAME

Jerry M. Conley, Director

SMOLT CONDITION AND TIMING OF ARRIVAL

AT LOWER GRANITE RESERVOIR

Bonneville Power Administration Project No. 83-323B

Period Covered: 14 February 1983 to 30 September 1983

by

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF TABLES (Continued)

LIST OF FIGURES

LIST OF FIGURES (Continued)

LIST OF FIGURES (Continued)

ABSTRACT

Most of Idaho's 5.2 million hatchery chinook were released into the river system in March and early April 1983. Median passage dates and migration rates at Whitebird and Red Wolf (head of Lower Granite Reservoir) were determined for chinook released at the South Fork Salmon River, Decker Flats, Pahsimeroi and Rapid River (Fig. 1).

Salmon River water temperature and day length were the most significant variables affecting migration rate. Salmon and Snake River discharges, depth of visibility and water velocity had lesser effects.

Nearly 3.2 million steelhead smolts were released in Idaho in 1983, generally from mid-April onward so as not to overlap with the chinook migration. In the Salmon River so few hatchery branded steelhead were obtained at Whitebird that no analyses of travel time and migration could be made.

In the Clearwater River system, branded releases of chinook from Kooskia NFH had median travel times of 15 days to Red Wolf, migrating 5.4 miles/day. Chinook from Dworshak NFH migrated slower at 2.5 miles/day. Dworshak steelhead migration rates varied from 3.7 miles/day to 22.0 miles/day. The variable most significantly affecting Clearwater River smolt migration was river discharge.

We branded 17,096 chinook and 2,232 steelhead smolts at Whitebird. Investigators at Lower Granite Dam estimated that from these releases, 9,700 chinook (57%) and 883 steelhead (40%) passed Lower Granite Dam, indicating a differential survival between chinook and steelhead smolts.

Rate of descaling as an indication of fish condition was recorded at hatcheries and release sites just prior to release and daily at the Whitebird and Red Wolf traps. Percent descaling of chinook ranged from 0.0 to 7.4% at the hatcheries. Maximum descaling occurred among Dworshak chinook reared in warmer water. Descaling of steelhead at hatcheries ranged from 0.0 to 3.0%.

Scattered descaling, where at least 10% of the scales are missing from at least one side in a scattered fashion, ranged from 0.8 to 49.3%. The groups which suffered highest classical descaling also suffered highest scattered descaling. Descaling rate did not increase at release sites.

Descaling at the Whitebird scoop trap was low for chinook and wild steelhead, generally being less than 5%. Descaling of hatchery steelhead steadily increased from 0.0 to 30% from mid-April through late May. The large difference in descaling between wild and hatchery steelhead leads to the conclusion that increased descaling is somehow associated with the hatchery rearing or loading and transport to release site.

The descaling rate of hatchery steelhead was considerably less at Red Wolf than at Whitebird, while descaling rates for chinook and wild steelhead were unchanged. There are two possible reasons for this difference: 1) catch of hatchery steelhead at Red Wolf contained a large percent of Dworshak steeliead which had low descaling rates, or 2) a large percent of the descaled hatchery steelhead as observed at Whitebird died and did not reach Red Wolf.

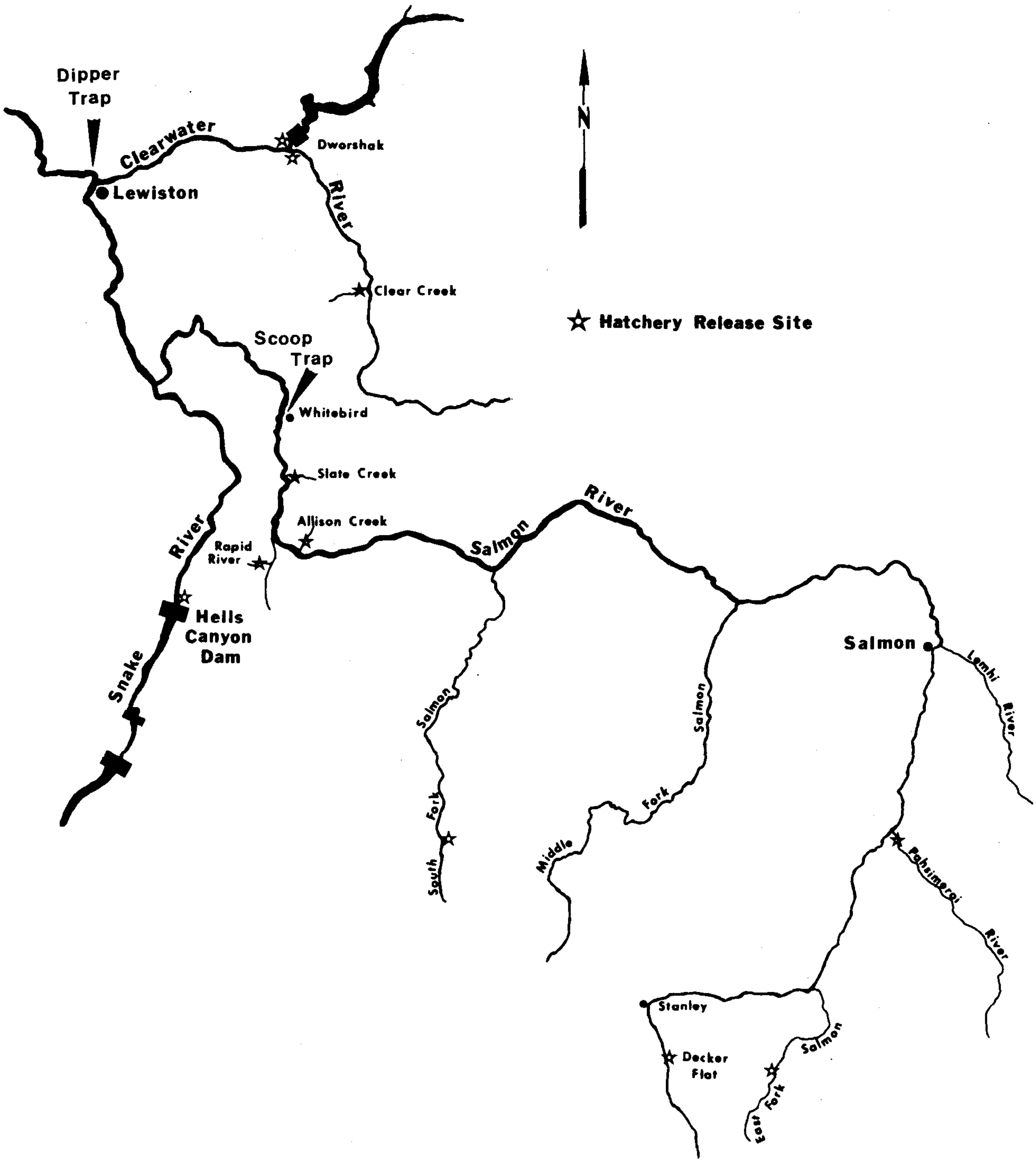


Figure 1. Location of the eleven release sites for hatchery-reared anadromous fish in Idaho, 1983.

List of Special Terms and Acronyms used in this Report

1. BKD = bacterial kidney disease.
2. cfs = cubic feet per second = 0.028 meters per second.
3. Chinook = chinook salmon (*Oncorhynchus tshawytscha*)
4. Classical descaling = a condition where at least two of the five generally equal sized scaled areas on one side of a fish are missing at least 40% of their scales.
5. EF = electro-fishing.
6. fps = feet per second = 0.3048 meters per second.
7. Length = total length, for chinook, fork length equals total length (.915).
8. LFD = length frequency distribution.
9. LGD = Lower Granite Dam.
10. NFH = National Fish Hatchery.
11. NMFS = The National Marine Fisheries Service.
12. "Other" descaling = descaling less significant (only one area descaled) or different (one area descaled on each side of a fish) from classical descaling.
13. Red Wolf = location of the migrant dipper trap used in this study. It is at Snake River mile 135, one mile downstream from the mouth of the Clearwater River, near the head of Lower Granite Reservoir.
14. SPCH = spring chinook - chinook salmon which generally migrate to the sea when one year old and return to spawn in the spring of the year.
15. Steelhead = steelhead trout (*Salmo gairdneri*).
16. STHD = steelhead.
17. Whitebird = location of the migrant scoop trap used in this study. It is located at Salmon River mile 53, 106 miles upstream from the head of Lower Granite Reservoir.
18. YOY = young-of-the-year.

INTRODUCTION

The Pacific Northwest Electric Power Planning and Conservation Act of 1980 (P.L. 96-501) directs that the Northwest Power Planning Council "promptly develop and adopt...a program to protect, mitigate and enhance fish and wildlife, including related spawning grounds and habitat, on the Columbia River and its tributaries." This act brings important new tools to the effort of mitigating fish and wildlife losses caused by hydro-electric dams in the Columbia River drainage. Section 4(h) of the Act explicitly gives the Bonneville Power Administration (BPA) the authority and responsibility to use its legal and financial resources "to protect, mitigate and enhance fish and wildlife to the extent affected by the development and operation of any hydro-electric project of the Columbia River and its tributaries in a manner consistent with...the program adopted by the Council...and the purposes of this Act".

Water storage for hydro-electric generation can severely reduce water flows necessary for downstream smolt migration. Therefore, the Northwest Power Planning Council has proposed a "water budget" for augmenting spring flows. This approach allows water budget managers to shape flows during the period of April 15 through June 15 by using up to 1.9 million acre feet of stored water as specified by the Council and called the Water Budget. To provide necessary information on smolt movement a comprehensive system-wide smolt monitoring program is being developed to provide the means to effectively manage the water budget and river operations for maximum protection of downstream migrating smolts.

The objectives of this project are to:

1. Develop a technique to index the relative magnitude of smolt abundance at any given time at the upper end of Lower Granite Reservoir.

2. Establish timing and success of outmigration for the various groups of hatchery products and wild Chinook salmon and steelhead smolts as they leave the Salmon River drainage.

3. Establish travel time from the Salmon River index site at Whitebird to the indexing site at the upper end of Lower Granite Reservoir.

4. Correlate travel time with river flows from indexing sites to Lower Granite Dam.

5. Assist in estimating total fish abundance and collection efficiency at Lower Granite Dam.

6. Determine where, when and to what extent descaling occurs to salmon and steelhead smolts released from Snake River hatcheries above Lower Granite Dam and develop management alternatives to correct the problem.

The fulfillment of these objectives will ultimately measure the progress and success of the migration of various stocks and species of fish from hatcheries and tributary streams to the head of Lower Granite Reservoir. This pertinent inforanation is essential for the effective management of the water budget above Lower Granite Dam.

METHODS

Salmon River (Whitebird) Index Site

A floating, self-cleaning scoop trap (Raymond and Collins 1974) was reconditioned by the National Marine Fisheries Service and installed at the Whitebird trap site located approximately one-half mile below the mouth of Whitebird Creek. The opening of the scoop trap is located on the outside of a gentle river bend. It is positioned immediately below a rock shelf which diverts the downstream migrants into the upper portion of the water column where they are susceptible to capture by the scoop trap. River width at this point is approximately 70 m. River depth is dependent on discharge and varies from about 2 m at 6000 cfs to 5 m at 25,000 cfs. Trap operation began on March 22, 1983 and continued until high water forced the trap shutdown on May 24, 1983.

The trap was checked and fish processed three to four times daily during the early part of the sampling season. During the later part of the smolt migration, the trap was checked twice daily as fewer fish were being captured at that time.

Fish were placed in a plastic washtub and anesthetized with Tricain Methane Sulfonate (MS-222). Up to 300 fish were measured and examined for descaling at each sample time. Smolts were then held in a 78 liter recovery tank supplied with oxygen until they again swam normally before being released to the river. During the latter part of the sampling season, a maximum of 200 fish were measured and examined for descaling per sampling period.

Beginning April 6, up to 1,000 smolts were freeze branded daily with liquid nitrogen chilled brands. The brand used was "R" which could be used in any of four rotations (R,2,d,c) and four locations, resulting in 16 possible unique brands (Raymond 1979). The left and right dorsal locations are between the lateral line and the dorsal fin on the left and right side of the fish. The left and right anterior locations are immediately posterior to the operculum and immediately dorsal to the lateral line. The brand was changed every three days so we could estimate travel time from the Whitebird site to the Lower Granite trap site and Lower Granite Dam. Branding continued until trap operations were discontinued on May 24. The first 200-300 fish in each sample were measured and examined for descaling and for hatchery brands or marks. If not already branded, they were freeze branded at our trap site. An additional 700-800 unmeasured fish were examined for brands and if not marked, were branded and released. Trapped smolts in excess of the 1,000 which were branded at the Whitebird trap were enumerated. These fish were not measured nor checked for marks or brands. During the latter part of the trapping season, generally less than 1,000 smolts were captured within a 24-hour period so all unmarked fish entering the trap were branded.

Trap efficiency was tested several times during the sampling season. Fish were held in a 1:120,000 (10.f mg/78 L) solution of Bismark Brown Y (an Eastman Kodak product) for three hours. Up to 200 salmon and steelhead smolts were dyed and released, on both sides of the river, above the mouth of Whitebird Creek, approximately 1/2 mile above the trap. Efficiency tests were conducted on alternate days from May 1 through May 9. Not enough fish were captured in the scoop trap after this time to warrant dyeing for efficiency tests.

When river discharge exceeded approximately 15,000 cfs, fish were being washed out of the scoop trap live box due to river surging. Bismark Brown Y dyed fish were placed in the live box to test live box retention on May 21 and 22.

In addition to sampling smolts, we monitored several abiotic parameters. Water velocity and temperatures were recorded during the morning and evening samples. Water velocity (f/sec) was estimated using a Scientific Instruments Company flow meter (bucket wheel type) at the front of the scoop trap at a depth of one-half meter. Settleable solids were sampled daily using an Imhoff settling cone, allowing 6-8 hours settling time. Secchi disc transparency was determined daily from a boat drifting with the current so that the secchi disc would be perpendicular to the water surface.

Descaling and fin damage were recorded on 200-300 fish from both the morning and evening sampling periods. Each side of the fish was divided into five areas as shown on the juvenile descaling form (Fig. 2). An area was determined to be descaled if 40% or more of the scales from an area were missing. A fish was considered to have patchy or scattered descaling if 10% of the scales were missing from a side in a patchy or scattered fashion. If two or more areas on one side of the fish were descaled, the fish was classified as being descaled. Fin damage and splits, head injuries and mortalities were also recorded.

<u>Upper Lower Granite Reservoir (Red Wolf) Index Site</u>

A migrant dipper trap (Mason 1966) was installed at the upper end of Lower Granite Reservoir. Krcma and Raleigh {1970) successfully used a similar dipper trap in the Snake River near Weiser, Idaho, to capture downstream migrants. The migrant dipper consisted of a trap section 12.2 m long, 2.6 m wide and 1.8 m deep with fixed louver leads that extended 6.1 m upstream at a 10° angle to the flows (Raymond and Collins 1974). The mouth of the trap was 7.9 m wide and 2.1 m deep. The dipper pan and self-cleaning screen, which forms the back of the trap, were operated by 1/3 hp electric motors. Electrical power was provided by a 4,000 watt generator which was placed on a barge which floated behind the trap.

JUVENILE DESCALING FORM (IDFG)

RECORDER__________________

SITE TAKEN______________ DATE___________ TIME_______ RIVER___________

RIVER CONDITION____

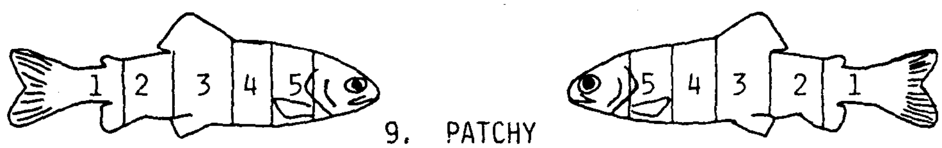
S.D. TRANSPARENCY______________ DISCHARGE_____________ DEBRIS__________?

M1 SEDIMENTATION________________ WATER TEMPERATURE____________________

REMARKS, PROBLEMS, SUGGESTIONS:______________________________

____

RIGHT LEFT



9. PATCHY

6. SCATTERED 7. EYE/HEAD INJURIES 8. DEAD

	DESCALED* Length	Descal.	CHINOOK Length	Descal.		DESCALED* Length	Descal.	STEELHEAD Length	Descal.
1					1				
2					2				
3					3				
4					4				
5					5				
6					6				
7					7				
8					8				
9					9				
10					10				
11					11				
12					12				
13					13				
14					14				
15					15				
16					16				
17					17				
18					18				
19					19				
20					20				
21					21				
22					22				
23					23				
24					24				
25					25				

TOTAL FISH SAMPLED_________ TOTAL FISH SAMPLED__________

TOTAL DESCALED____ % DESCALED_______ TOTAL DESCALED______ % DESCALED_____

*40% DESCALING (ABOVE BELLY) IN ANY SINGLE (1) AREA CONSTITUTES DESCALING. ANY TWO (2) AREAS ON THE SAME SIDE RESULTS IN FISH CLASSIFIED AS DESCALED.

Figure 2. Juvenile descaling form for recording data on sampled smolts. The drawings show ten areas on a fish which are examined for scale loss.

The Red Wolf trap was positioned about 80 meters downstream from the Red Wolf Crossing Bridge near Lewiston (Fig. 1) and held in position by cables from each lead to the bridge. The trap was 1.5 miles downstream from the confluence of the Snake and Clearwater rivers. The trapping site was on the south side of the river on the inside of a gentle bend. This location was selected because the trap was out of the major shipping lane and on the opposite side of **the** river from the Clearwater-Snake mixing zone. The river at the Red Wolf location is approximately 310 meters wide and 12 meters deep.

The trap was installed and became operational on April 19, 1983. The trap operated, with several short breakdown periods, until June 29, 1983.

All salmon and steelhead smolts captured in the Red Wolf trap were measured and examined for descaling and brands. Fish were dipped from the live box and anesthetized with MS-222 in a washtub supplied with an aeration system before being examined. After examination, the fish were placed in an aerated recovery tank before being returned to the river.

Other parameters sampled at the Red Wolf trap site were temperature, velocity, turbidity and settleable solids using the same methods and materials as described for the Whitebird scoop trap operation.

Alternate Sampling Methods

Electrofishing techniques were tested as a supplemental sampling method. A Smith-Root SR-19 electrofishing boat was employed to capture fish at nine sites within the Salmon, Clearwater and Snake systems.

The Salmon River sites were located from the mouth of Whitebird Creek to one-quarter mile below Hammer Creek landing and a one-half mile section at the mouth of the Salmon River. Only those areas with low velocities were electrofished. The Whitebird site was sampled once on April 29 and 30. During the May electrofishing period, Salmon River discharge was high and the river was too dangerous to electrofish. The site at the mouth of the Salmon River was sampled once on June 1.

Electrofishing was conducted at three sites on the Clearwater River. The lowest area electrofished on the Clearwater River was the south shore from its mouth upstream about one mile. Sampling was conducted on April 27 and 28, and May 31. The mid-Clearwater River section was located on both sides of the river from Lower Myrtle Hole (RM 16) downstream about one-half mile. Electrofishing was conducted on May 2 and June 4. The upper site was on both sides of the river from Cherrylane Bridge (RM 21) downstream about one mile. Dates sampled were May 2 and June 4.

The uppermost electrofishing site on the Snake River was along the west shore at Clarkston between the Southway and Interstate Bridges. The site was sampled on April 28 and May 31. A one-half mile section adjacent to the Red Wolf trap site (both sides of the river) was sampled on April 27 and 28, and May 31. The north shore of Lower, Granite pool from just below Wawawai to the face of the dam (approximately two miles) was electrofished on May 1 and.June 5. The farthest downstream sample site was the south shore of Little Goose pool adjacent to Boyer Park on June 6.

We fished a 300' x 6' beach seine from two beaches along the middle Clearwater River. One end of the net was secured to the beach while the net was rapidly set in a line perpendicular to the beach, using a motor-boat. River current then swung the net in an arc to the bank downstream. The net was then hauled to the beach from both ends.

Descaling at Hatcheries and Release Sites

In addition to descaling data collected at trap sites and during electrofishing, fish were sampled at hatcheries prior to release and at release sites either just prior to release or immediately after release. Descaling data were collected from Dworshak NFH and Kooskia NFH by project staff members. All descaling information from other hatcheries was collected by hatchery personnel and area biologists. Descaling data were collected from different treatment lots of fish; for example, if several groups of fish had varying degrees of kidney disease, each group of fish was examined separately. Descaling was determined on 200-300 fish from each individual group of fish. If one particular group of fish was distributed in four raceways, then 75 fish were examined from each raceway.

Descaling information at release sites was collected, if possible, after fish were released by dipping fish from the river or stream down-stream from the release point. If collection of fish after release was impossible, fish were sampled prior to release by dipping fish directly from the transportation truck or hatchery raceway. Fish were anesthetized with MS-222 before they were examined and if released into a stream, they were allowed to recover before being released.

RESULTS AND DISCUSSION

Hatchery Releases

Chinook salmon were reared at six hatcheries within Idaho and re-leased at nine locations in Idaho and Washington during the spring of 1983 (Fig. 1). Location, date of release, species and numbers released are represented in Table 1.

Of the 4,931,200 spring chinook salmon raised in Idaho and released in 1983, 3,617,000 were released to the Salmon River system. Red River received 95,400 young-of-the-year (YOY) spring chinook. Clear Creek received 217,200 YOY spring chinook and 224,800 spring chinook smolts. Dworshak NFH released 26,900 spring chinook smolts into the Clearwater River and 49.9,900 smolts into the North Fork Clearwater River. The Snake River just below Hells Canyon Dam received 25.0,000 spring chinook smolts. 183,900 summer chinook salmon smolts were released into the South Fork

Table 1. Location, date and number of chinook salmon released into the Snake River system above Lower Granite Dam, 1983.

Release site	Hatchery	Date of release	Species	Numbers released
*	Pahsimeroi (RM 817.5)	3/10	Sp. Chinook	451,022
Salmon R. Decker Flats	McCall (RM 896.7)	3/29	Sp. Chinook	167,895
S. Fk. Salmon	McCall (RM 719.1)	4/4-7	Summer Chinook	183,896
*	Rapid R. (RM 605.4)	3/26	Sp. Chinook	2,998,103
Snake Hells Canyon	Rapid R. (RN 571.3)	3/18	Sp. Chinook	250,020
Red R.	Hagerman NFH (RM 612.8)	6/7	YOY Sp. Chinook	95,414
Clear Cr.	Hagerman NFH (RM 541.6)	6/14	Sp. Chinook	87,168
Grande Ronde	Hagerman NFH (RM 615.1)	6/16	YOY Fall Chinook	78,895
N. Fk* Clearwater River	Dworshak NFH (RM 504.2)	12/16/82	Sp. Chinook	28,100
		3/28	Sp. Chinook	24,190
		3/29	Sp. Chinook	310,329
		4/1	Sp. Chinook	137,329
Clearwater R.*	Dworshak NFH (RM 504.2)	3/29	Sp. Chinook	26,874
Clear Cr.*	Kooskia NFH (RM 541.6)	4/12	Sp. Chinook	137,597
Clear Cr.		5/30	YOY Sp. Chinook	122,546
		6/13	YOY Sp. Chinook	94,640

*Released directly from the hatchery.

Salmon River and 78,900 YOY fall chinook salmon were released into the Grande Ronde River. This is a total of 5,194,000 chinook salmon released to the Snake River system above Lower Granite Dam in 1983.

Steelhead trout were raised at four hatcheries in Idaho and released at ten locations within *the* state (Fig. 1). Steelhead were also released in one Washington river and one Oregon river which flows into the Snake River above Lower Granite Reservoir. These fish were reared at two hatchery facilities in Washington and one in Oregon. Table 2 shows the release site, hatchery which produced the smolts, date of release and number released.

I'otal steelhead smolts reared in Idaho and released to Idaho streams was 3,156,400. Total steelhead trout reared and released to Washington streams above Lower Granite Dam was 227,600. The Irrigon Hatchery released 71,700 steelhead smolts into a tributary of the Imnaha River in Oregon.

Steelhead smolts were released in the Salmon River from three hatcheries located in the Thousand Springs area of southern Idaho. Approximately one-third of the steelhead (1,055,600) released in Idaho streams were put in the Salmon River system and the remaining two-thirds into the Clearwater River. The Middle Fork of the Clearwater River at Ahsahka received 1,225,900, the North Fork Clearwater River received 35,200, the South Fork Clearwater received 496,500 and Clear Creek received 250,200. Total release of steelhead smolts to the Clearwater River system was 2,008,000. The Snake River below Hells'Canyon Dam received 92,800. The Grande Ronde River system in Washington received 226,600 steelhead smolts. The Imnaha River, Oregon, received 71,700 steelhead smolts.

Freeze Branded Smolt Releases

Twenty groups of hatchery chinook and steelhead juveniles received unique freeze brands and were released at sites within Idaho (Table 3). Two marked groups were also released to the Grande Ronde River, Washington. Additionally, 16 unique branded groups were marked at the Whitebird trap and released throughout the trapping season to estimate travel time to Lower Granite Reservoir (Table 4). The National Marine Fisheries Service also branded 11 unique groups of fish and released them at Wilma, Washington to determine travel time from the head of Lower Granite pool to Lower Granite Dam (Table 5).

Whitebird Scoop Trap

The Whitebird scoop trap was operated from March 22, 1983 until May 24, 1983 and captured 86,143 chinook salmon smolts and 2,370 steelhead trout smolts (Table 6). Freeze branding operations commenced on April 6. We branded 17,094 chinook and 2,130 steelhead smolts from then until May 23. The Lower Granite Dam collection facility captured 2,350 chinook and 423 steelhead smolts which were branded at Whitebird. This information was used to calculate smolt travel time and survival rate from the lower Salmon River (RM 53) to Lower Granite Dam. Median travel time ranged from 14 days in early April to five days during mid-May (Table 4).

Table 2. Location, date and numbers of steelhead trout released into Snake River system above Lower Granite Dam, 1983.

Release site	Hatchery	Date of release	Species	Numbers released
PAHSIMEROI RIVER	Hagerman NFH	3/28-31	Steelhead "A"	84,194
	Niagara Sp.	4/4	"	29,250
		4/5	"	28,470
	(River mile from	4/6	"	20,150
	ocean=RM 817.5)	4/7	"	20,150
		4/8	"	17,550
		4/9	"	21,450
		4/10	"	21,450
		4/11	"	24,050
		4/12	"	24,050
		4/13	"	21,450
		4/18	"	22,100
		4/19	"	22,100
		4/21	"	26,000
		4/22	"	26,000
		4/23	"	26,000
		4/24	"	21,450
		4/25	"	21,450
		4/26	"	22,440
		4/27	"	24,330
		5/2	"	29,250
		5/3	"	27,000
	Magic Valley	4/18	"	8,856
		4/18	"	7,744
		4/19	"	24,081
			Subtotal	621,015
EAST FORK SALMON RIVER	Hagerman NFH	4/11-12	Steelhead "A"	31,348
		4/12-13	Steelhead "B"	38,864
		4/4-11	"	162,723
	Niagara Sp.	4/12	"	26,640
		4/13	"	19,610
	Magic Valley	5/2	"	13,200
		5/3	"	12,900
	(RM 873.6)	5/5	"	13,800
		5/6	"	7,240
			Subtotal	328,325

Table 2. Continued.

Release site	Hatchery	Date of release	Species	Numbers released
SALMON R. DECKER FLATS	Hagerman NFH (RM 896.7)	4/18-20 4/18-21	Steelhead "A" Steelhead "B" Subtotal	40,573 26,173 66,746
SNAKE RIVER HELLS CANYON	Niagara Springs (RM 571.3)	4/20 4/20 4/20 4/20 4/20 4/20	Steelhead "A" " " " " " Subtotal	19,600 8,400 19,600 19,500 21,000 4,650 92,750
ALLISON CREEK	Magic Valley (RM 609)	4/22	Steelhead "B"	7,340
SLATE CREEK	Magic Valley (RM 579)	4/26	Steelhead "B"	32,200
GRAND RONDE RIVER	Lyons Ferry Wallowa (RM 615.1)	5/4-9 5/6 4/25,27,29	Steelhead Steelhead Steelhead Subtotal	147,319 23,058 57,250 227,627
IMNAHA RIVER	Irrigon (RM 554.8)	5/2-5	Steelhead	71,707
CLEARWATER RIVER	Dworshak NFH (RM 504.2)	4/13 4/20 5/3 5/4 5/5 5/9 5/10 5/12	Steelhead "B" " " " " " " "	36,150 33,854 35,931 238,361 179,581 69,651 29,938 30,215

Table 2. Continued.

Release site	Hatchery	Date of release	Species	Numbers released
CLEARWATER RIVER	Dworshak NFH	5/13	Steelhead "B"	91,296
		5/16	"	82,106
		5/18	"	99,663
		5/19	"	40,914
		5/23	"	23,974
		5/25	"	33,124
		5/25	"	48,328
		5/26	"	152,849
			Subtotal	1,225,935
S. FK. CLEARWATER RIVER	Dworshak NFH	5/9	Steelhead "B"	101,289
		5/10	"	104,685
	(RM 552.0)	5/11	"	96,734
		5/12	"	92,676
		5/13	"	101,087
			Subtotal	496,471
CLEAR CREEK	Dworshak NFH	5/11	Steelhead "B"	94,530
		5/12	"	97,239
	(RM 541.6)	5/13	"	58,659
			Subtotal	250,428
N. FK. CLEARWATER	Dworshak NFH	5/3	Steelhead "B"	35,177
	(RM 504.2)			
			TOTAL	3,455,721

Table 3. Brand, release site, 50% arrival date and travel time for chinook salmon and steelhead trout to Whitebird and Lower Granite, 1983.

Ranked group released	Release site	Species	River miles from release site to: White-bird	Red Wolf	LGD	50% release date	50% arrival date @ Whitebird	50% arrival date @ Lower Granite Dam	Travel* time to Whitebird (days)	Travel time to Lower Granite Dam (days)	Salmon River Average Q	Snake River* @ Lower Granite Dam Average Q
RDT 1	S. Fk. Salmon River	Sp.Ck.	154	260	288	4/5	4/23	5/7	16	32		
RDT 2	Salmon R. @ Decker Flat	Sp.Ck.	331	437	465	3/29	4/29	5/5	30	37		
RDT 3	Snake R. @ Hells Canyon	Sp.Ck.	-	111	140	3/18		4/14	-	27		
RD 121	Rapid River	Sp.Ck.	40	145	174	3/26	4/4	4/23	8	-		
RD 121	Snake R. @ Hells Canyon	Sp.Ck.	-	111	140	3/18		4/23	-	-		
RD 121	Salmon R. @ Decker Flat	STHD	331	437	465	4/19		6/4	-	46		
RD 123	Salmon R. @ Decker Flats	STHD	331	437	465	4/19		6/9	-	51		
RD 124	Snake R. @ Hells Canyon	STHD	-		140	4/20		5/2	-	12		
RAT 1	Clear Creek	Sp.Ck.		82	110	4/8		4/28	-	20		
RAT 2	Clear Creek	Sp.Ck.	-	82	110	4/8		4/28	-	20		
LDT 1	Clear Creek	YOY Sp.Ck.		82	110	6/14		7/4	-	20		
LDT 4	Pahsimeroi	Sp.Ck.	251	357	386	3/10	4/13	4/22	31	43		
LD 12 1	E. Fk. Salmon R.	STHD	308	414	442	4/12		5/26	-	44		
LD 12 4	Pahsimeroi	STHD	251	357	386	4/19		5/13	-	24		
RAS 1	Grand Ronde River	STHD	-	156	183	5/6		5/17	-	11		
RAS 2	Grand Ronde River	STHD		156	183	5/6		5/24	-	18		
LDU 3	N. Fk. Clearwater River	Sp.Ck.		44	72	12/16		4/14	-	118		
RDU 3	N. Fk. Clearwater River	Sp.Ck.		44	72	4/1		4/23	-	22		
RAF 3	N. Fk. Clearwater River	STHD		44	72	5/3		5/11	-	8		
RAF 4	Clearwater River	STHD	-	44	72	5/25		5/30	-	5		
LAW 1	Clearwater River	STHD	-	44	72	4/20		5/6	-	16		
LAW 2	Clearwater River	STHD	-	44	72	5/3		5/9	-	6		

*Median travel time from point of release to point of recapture.

Table 4. Date of release, mean arrival time and travel time for chinook and steelhead branded at Whitebird, traveling to Lower Granite Dam.

Marked group released	Date 50% release	50% arrival date	Travel time (days)
RDR 1	4/6	4/19	13
RDR 2	4/10	4/24	14
RDR 3	4/13	4/27	14
RDR 4	4/16	4/26	10
LDR 1	4/20	4/28	8
LDR 2	4/22	5/1	9
LDR 3	4/24	5/2	8
LDR 4	4/27	5/4	7
RAR 1	5/1	5/10	9
RAR 2	5/4	5/11	7
RAR 3	5/7	5/16	9
RAR 4	5/10	5/19	9
LAR 1	5/13	5/18	5
LAR 2	5/16	5/27	11
LAR 3	5/19	5/25	6
LAR 4	5/22	5/31	9

Miles from Whitebird trap to Lower Granite Dam = 133.

Table 5. Mean (50%) travel time of marked chinook salmon smolts from Wilma (near Red Wolf) to Lower Granite Dam, April and May 1983.

Marked group released	Date of release	50% arrival date	Travel time (days)
LAC 1	4/14	4/21	7
LAC 3	4/20	4/25	5
LDC 1	4/26	4/30	4
LDC 3	4/30	5/4	4
RAC 1	4/12	4/19	7
RAC 3	4/18	4/23	5
RDC 1	4/22	4/26	4
RDC 3	4/28	5/3	5
LA 3L 1	5/4	5/7	3
RA 3L 1	5/2	5/6	4
RD 3L 1	5/6	5/10	4

River miles from Wilma to Lower Granite Dam = 26.9.

Table 6. Daily numbers of chinook and steelhead smolts branded at Whitebird.

Date	Brand	Chinook	Steelhead
4/6	RDR 1	940	
7	"	841	
8	"	-	
9	RDR 2	787	
10	"	1031	
11	"	1021	
12	RDR 3	1003	
13	"	1011	
14	"	1000	
15	RDR 4	1005	
16	"	775	
17	"	568	
18	LDR 1	220	
19	"		
20	"	1001	4
21	LDR 2	1001	5
22		1000	5
23		1003	0
24	LDR 3	245	15
25	"	3	4
26	"	154	87
27	LDR 4	280	258
28	"	84	83
29	"	148	7
30	RAR 1	206	25
5/1	"	193	29
2	"	237	34
3	RAR 2	271	45
4	"	196	42
5	"	115	53
6	RAR 3	34	76
7	"	168	186
8	"	85	117
9	RAR 4	69	128
10	"	60	124
11	"	38	33
12	LAR 1	23	64
13	"	10	31
14	"	9	43
15	LAR 2	34	57
16	"	42	62
17	"	47	76
18	LAR 3	33	63
19	"	16	47
20	"	19	28
21	LAR 4	17	77
22	"	19	82
23	"	30	136
24	"	2	4
	Total	17,094	2,130

Four groups each, of chinook and steelhead, were branded at hatcheries and released upstream from the Whitebird trap. At Whitebird, we observed 466 chinook and 9 steelhead which had been branded at hatcheries. We estimate that the trap caught 85, 298, 297 and 540 branded chinook smolts which represents 0.32%, 1.20%, 1.18% and 2.04% capture rates of the marked groups released at Decker Flats, the South Fork Salmon River, Pahsimeroi River and Rapid River, respectively. The largest daily recovery of brands was 33 chinook on March 20.

There was very little temporal overlap of chinook and steelhead with most chinook having passed Whitebird prior to April 25 when steelhead numbers increased (Fig. 3). Daily catches of steelhead were much less than chinook catches. Possible reasons for this are that: 1) steelhead passed the trap at river discharges which reduced trapping efficiency, 2) steelhead are larger than chinook and probably avoid the trap easier, and 3) steelhead in general migrate deeper than do chinook (Smith 1974), therefore, a larger percent of steelhead would pass under the trap entrance. Passage of wild and hatchery steelhead occurred simultaneously, and hatchery products outnumbered wild steelhead (Fig. 4).

At the beginning of the Whitebird trapping season, water temperature in the Salmon River was near the minimum required for smolt migration (6-7C) (Raymond 1979). No significant increase in temperature occurred until after April 15 at which time repeated warming and cooling cycles began (Fig. 5).

River discharge during the outmigration season is mostly a function of temperature (snow melt). Discharge remained low until April 5 when it increased from a low level of 6,000-7,000 cfs to about 20,000 cfs. Discharge decreased twice after that, but only to intermediate levels near 15,000 cfs. Discharge began increasing on May 21 and forced termination of trapping on May 24 at 37,000 cfs (Fig. 6). Discharge is calculated from a USGS water height gage at Whitebird. Water velocity (Fig. 6) and secchi disc (Fig. 7) are discussed later in the section on migration rates.

Red Wolf_Dipper Trap

The Red Wolf trap was operated from April 19 until June 29, 1983 and captured 3,019 chinook, 379 steelhead and 38 sockeye smolts. The purpose of the Red Wolf Trap was to document the arrival of smolts at the head of Lower Granite Reservoir by capturing branded smolts and by recording the relative abundance of smolts arriving daily. Neither objective was adequately achieved since the catch was *very* small. Only 35 branded chinook and two branded steelhead were captured during the 70 day trapping season, and there were not enough smclts available for marking in efficiency tests. Only one of the 19,220 smolts branded at Whitebird was recovered at Red Wolf. Location of the trap, which was away from the main current, is thought to be the main reason for small catches.

Arrival times of branded smolt groups at Red Wolf were calculated after the fact, in an indirect manner, by use of brand return data at

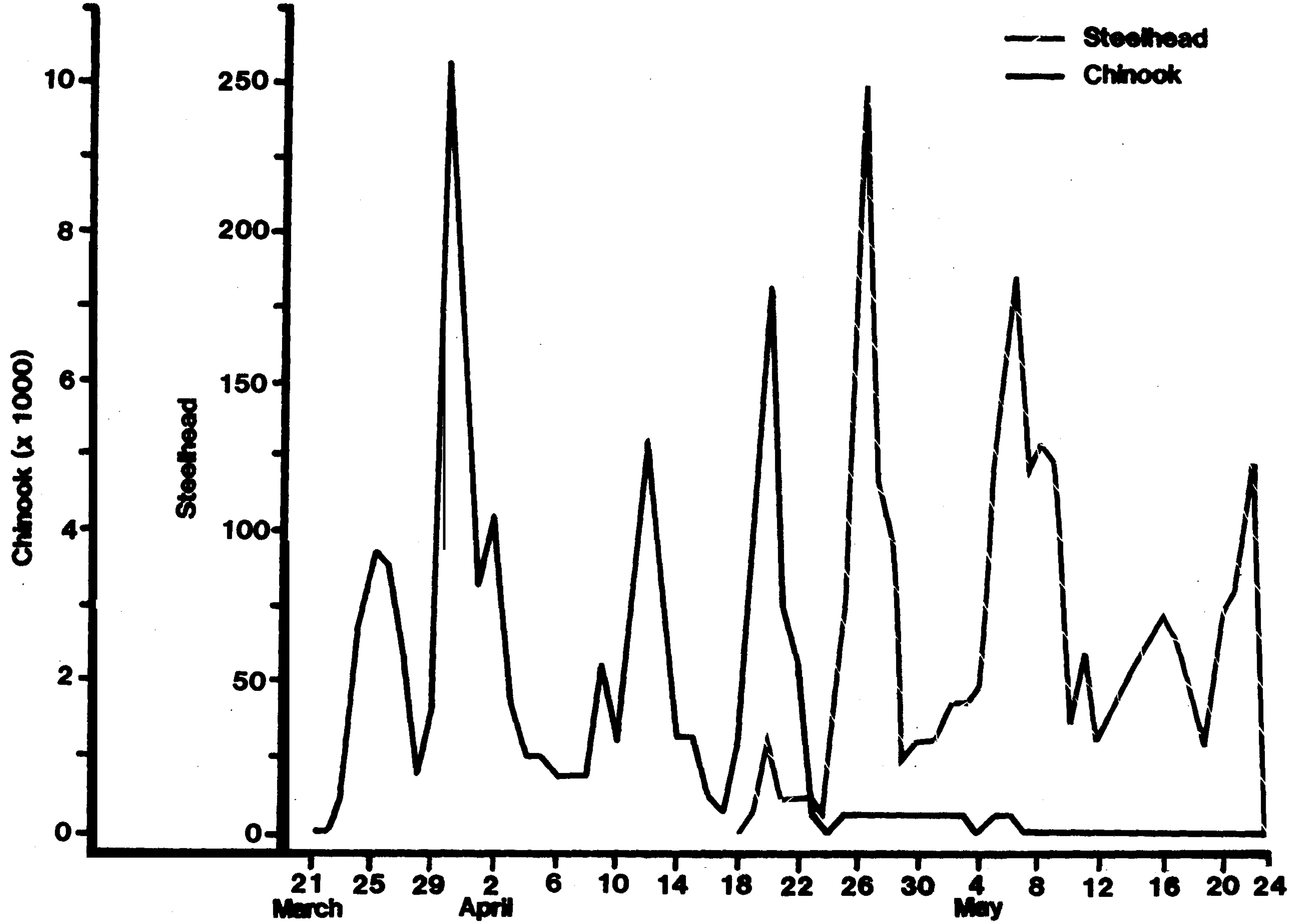


Figure 3. Daily total number of chinook and steelhead at the Whitebird scoop trap, 1983.

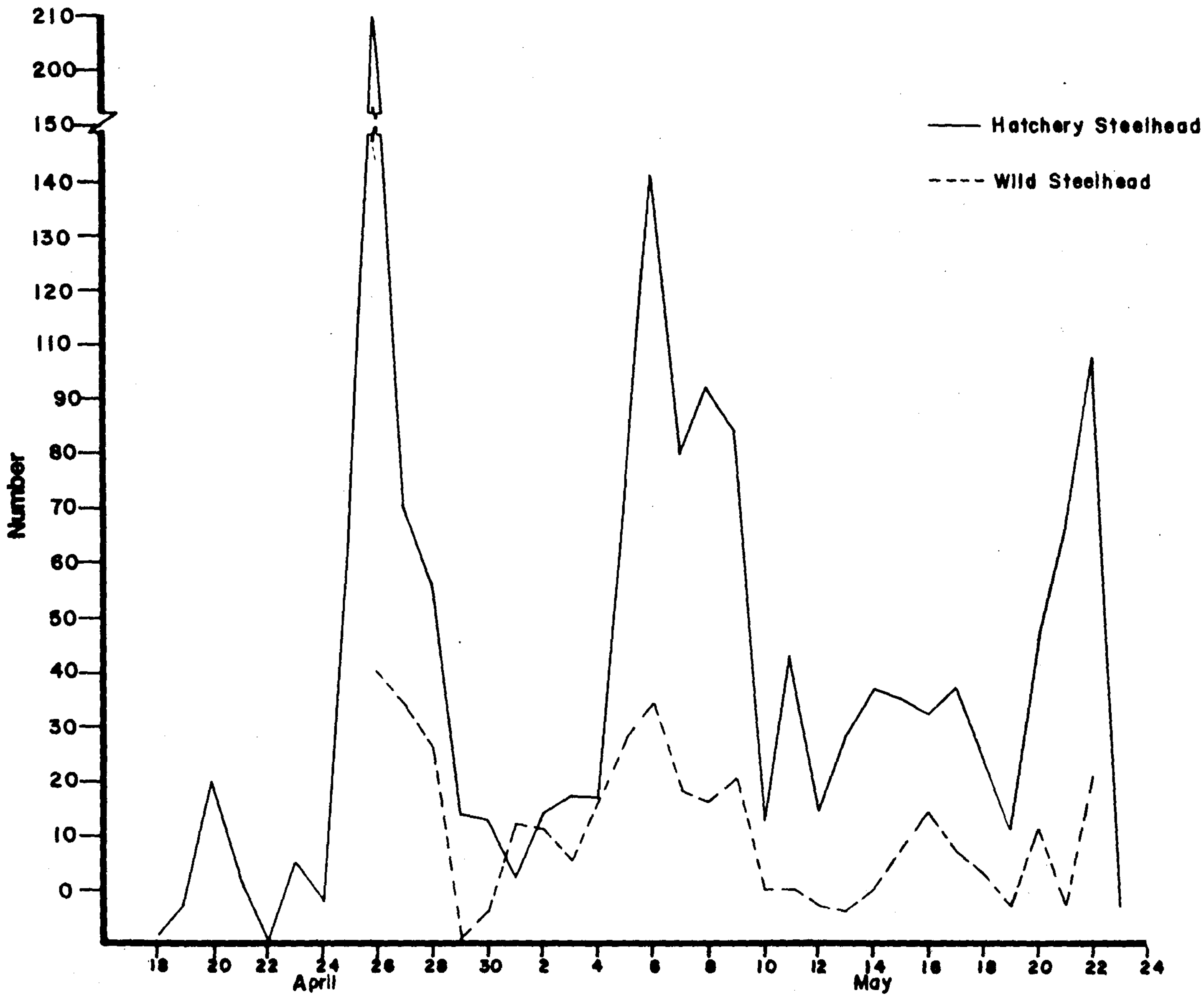


Figure 4. Daily total numbers of hatchery and wild steelhead at the Whitebird scoop trap.

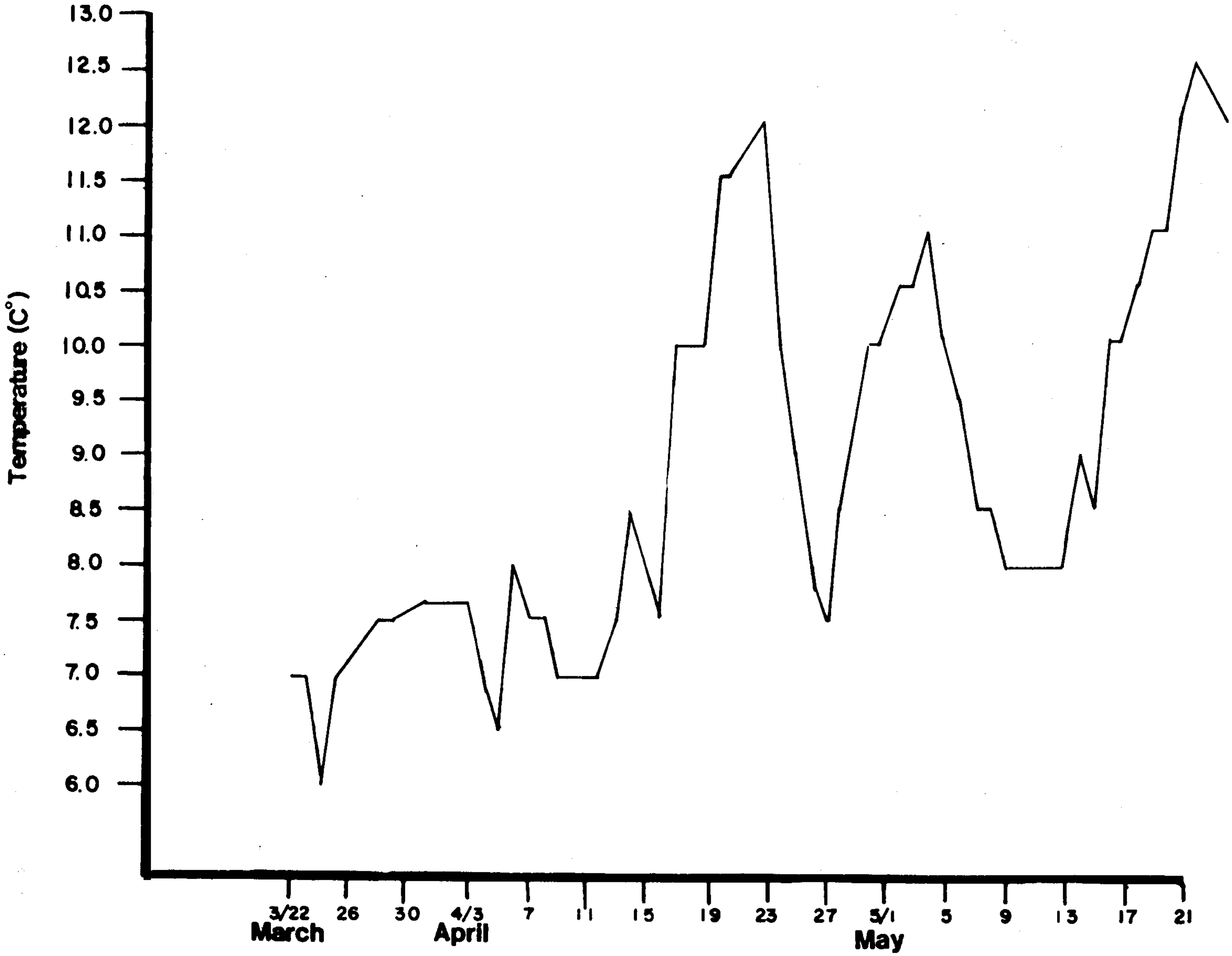


Figure 5. Daily water temperature at Whitebird scoop trap, 1983.

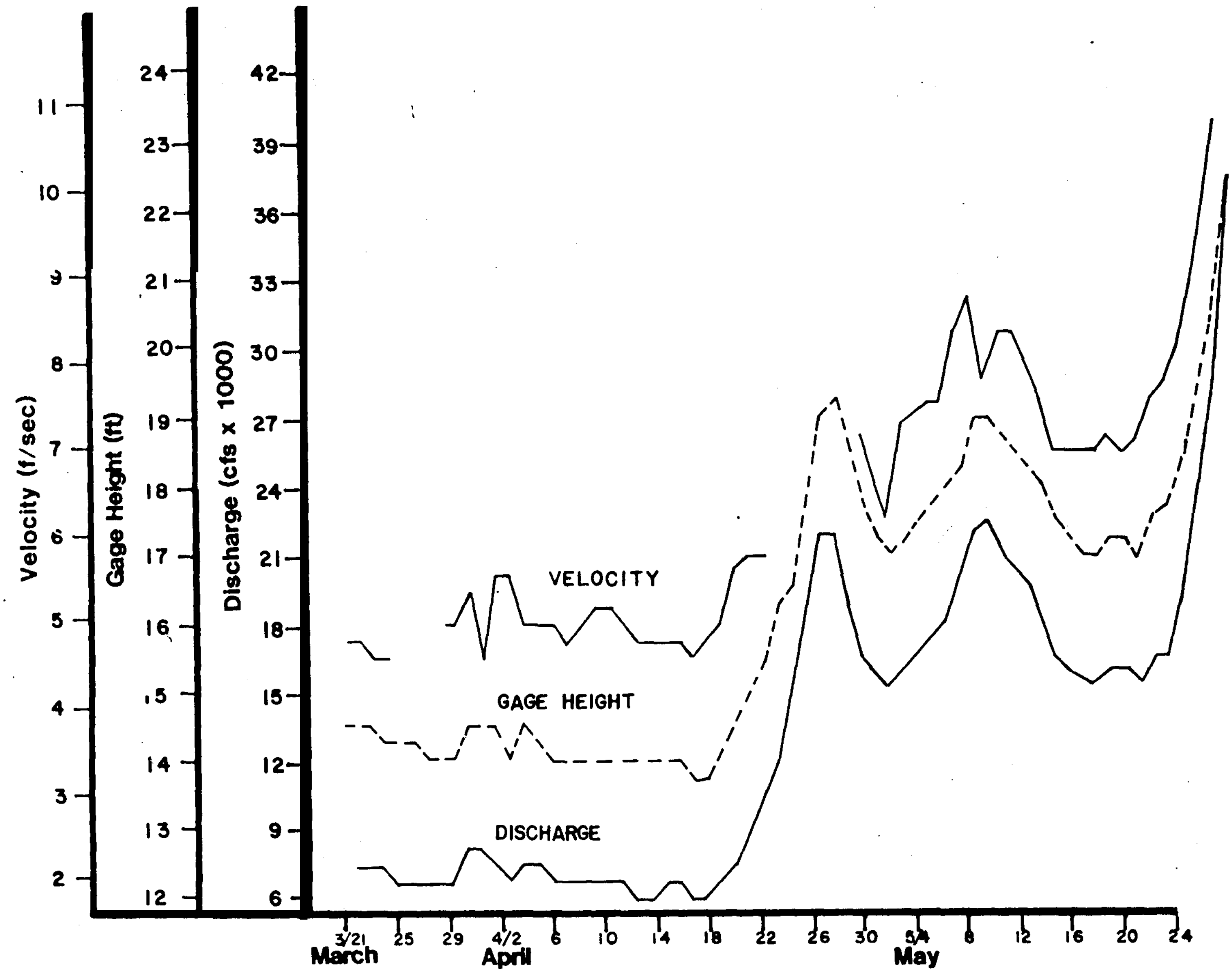


Figure 6. Daily velocity, gage height and discharge at Whitebird scoop trap.

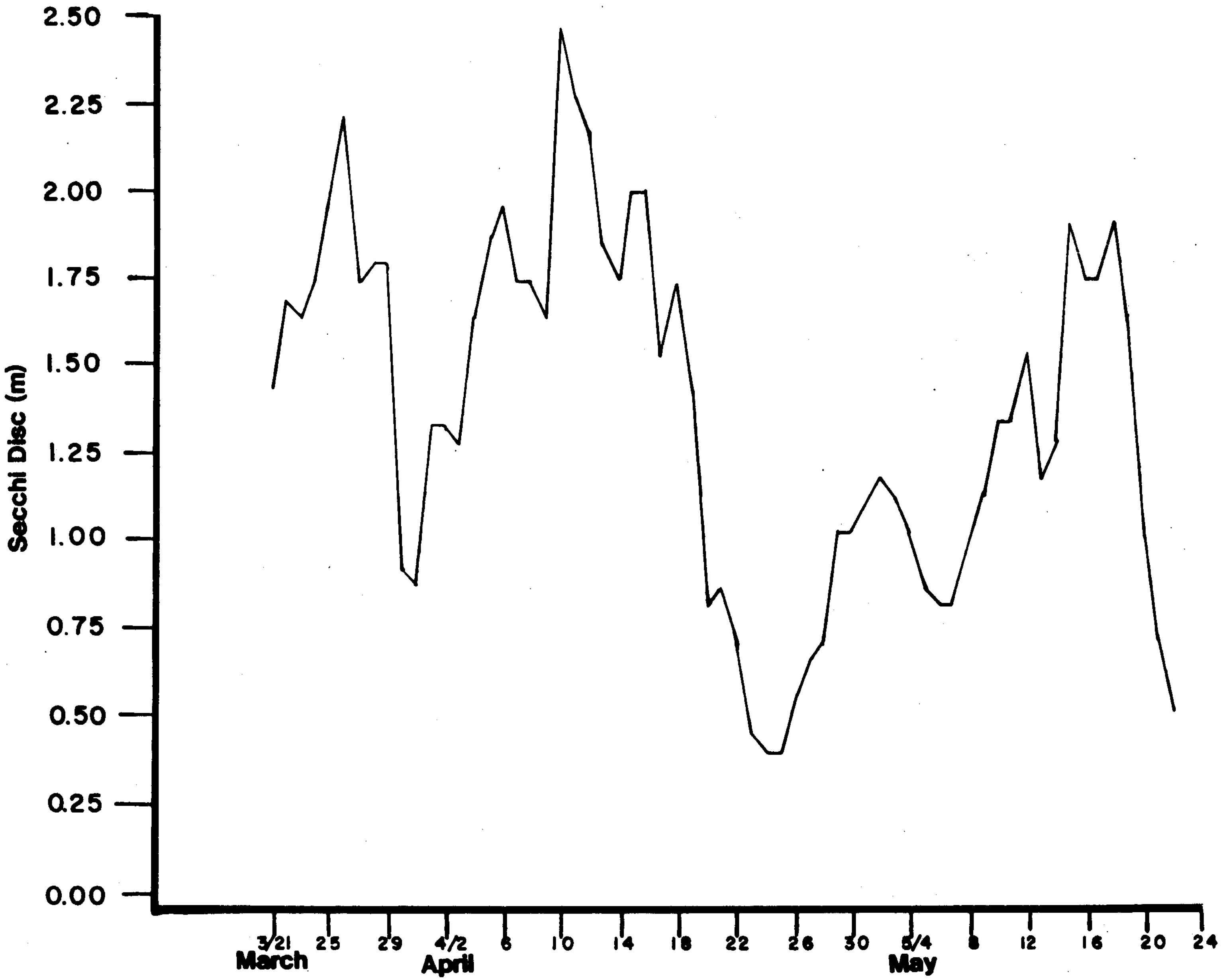


Figure 7. Daily depth of visibility of a 20 cm Secchi disc at the Whitebird scoop trap, 1983.

Lower Granite Dam and NMFS data on travel time from Wilma, near Red Wolf trap to Lower Granite Dam. This technique and results are discussed below.

Yearling chinook, hatchery steelhead and wild steelhead at Red Wolf averaged 123, 203 and 181 mm, respectively. All these values were smaller than mean lengths recorded at Whitebird from the same three groups where mean values were 129, 240 and 192 mm (Fig. 8). Hatchery steelhead released in the Salmon River are generally larger than those from the Clearwater River, i.e., the former generally average 230-240 mm and the latter, 190 mm. The smaller size of hatchery steelhead at Red Wolf may indicate that the majority of hatchery smolts caught there are from Dworshak NFH. There may also have been a greater mortality on very large steelhead smolts. In contrast, however, hatchery chinook smolts in the Clearwater River are larger than those in the Salmon River, yet chinook smolts caught at Red Wolf were smaller than those from the Salmon River. Many of the Dworshak chinook may have passed the Red Wolf area before we began trapping. Wild steelhead at Red Wolf were also smaller than at Whitebird. This may be an indication that most of the wild steelhead at Red Wolf came from the Clearwater River. Possibly, there is a general bias toward smaller fish in the dipper trap than in the scoop trap.

Travel Time and Migration Rates

Salmon River Hatcheries to Whitebird

Eight groups of branded smolts (four chinook and four steelhead groups) were released in the Salmon River upstream from Whitebird. We calculated travel time for migrating smolts from release sites to Whitebird as the number of days between the median release date and the median arrival date and rate of migration as the distance in miles from the release sites to Whitebird divided by the travel time. The daily number of observed brands was converted to estimated relative abundance of branded fish by first multiplying the ratio of observed branded smolts to total smolts sampled by the number of smolts captured in the trap that day. This expanded value was then divided by the estimated trap efficiency. For example, if five smolts with a particular type of mark were observed in a 100 smolt sample, and 400 fish were captured in the trap that day, then 5/100 x 400 = 20 branded smolts was the estimate of the number of smolts actually captured by the trap. If trap efficiency was estimated at 1.5% that day, then the estimated relative abundance of that particular marked group passing the trap that day was 20/.015 = 1,333.

Steelhead generally migrated later than chinook and passed the Whitebird trap when efficiency was so low that too few brands were observed for use in estimating travel time. Only nine brande'd steelhead from four brand groups were observed. Sample size for chinook smolts, however, was sufficient and median arrival time at Whitebird was estimated with 95% confidence intervals of ±1.4 to 12.3 days (Table 7). Temporal distribution of chinook smolts passing Whitebird was relatively dispersed with about two-thirds of smolts from.a given release group passing Whitebird within a 16-20 day interval.

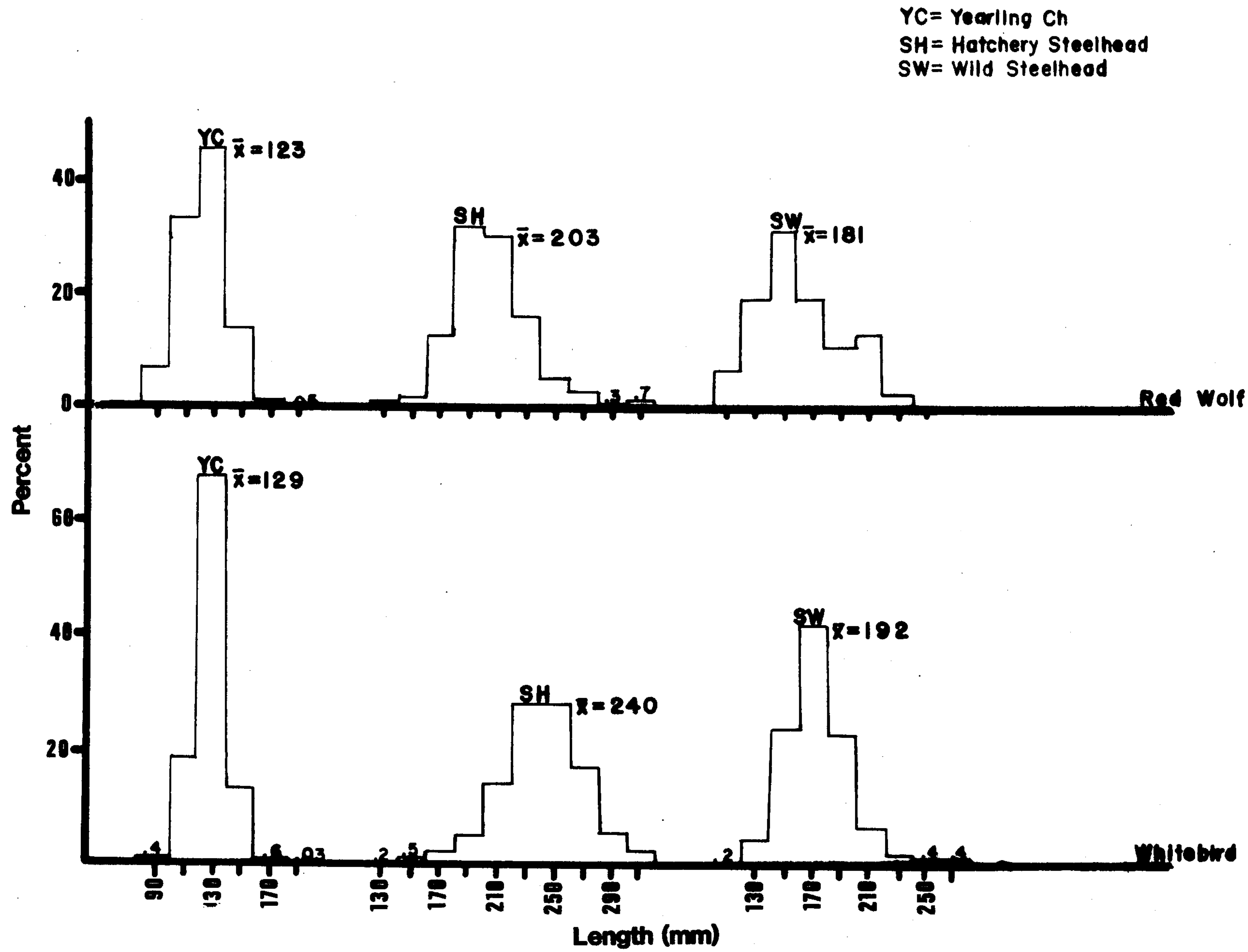


Figure 8. Comparative length frequency distribution of yearling chinook, hatchery steelhead and wild steelhead trapped at Whitebird and Red Wolf and grouped in 20 mm intervals, 1983. $\bar{x}$ = mean total length.

Table 7. Precision associated with estimating median arrival time of branded smolts at Whitebird.

Species	Source	(n)	Median arrival date	Standard deviation	95% confidence interval (days)
Chinook	S. Fk. Salmon	134	4/23	8.8 days	± 1.5
Chinook	Decker Flats	57	4/29	8.7 days	± 2.3
Chinook	Pahsimeroi	124	4/13	8.1 days	± 1.4
Chinook	Rapid River	149	4/4	10.3 days	± 1.7
Steelhead	Decker Flats	1	?	-	-
Steelhead	E. Fk. Salmon	5	*	12.1 days	± 15.0
Steelhead	Pahsimeroi	2	*	1.4 days	± 12.7
Steelhead	Decker Flats	1	?	-	-

*Sample size too small for meaningful estimate of median arrival date.

Migration rate from release sites to Whitebird for chinook ranged from 4.4 to 10.7 miles/day for chinook released from Rapid River and Decker Flats, respectively. We attempted to determine which environmental variables influenced migration rate. Variables considered include:

1. Day length (DL), the average daylight hours during the migration interval.

2. Salmon River discharge (SmnQ), the average daily discharge at Whitebird in thousands of cfs above a base level of 6,000 cfs. The daily values were averaged over the first half of the migration period as we assumed that smolts were in the Salmon River during approximately the first half of their journey from Whitebird to Lower Granite Reservoir.

3. Salmon River temperature (T), the average daily temperatures (^{0}C) during the first half of the migration period.

4. Salmon River transparency (S), the average Secchi disc value in meters during the first half of the migration period.

5. Snake River discharge (SnkQ), the average daily discharge in thousands of cfs above a base level of 40,000 cfs for the second half of the migration period.

Snake River temperature and Secchi disc transparency were not used since the former was significantly warmer than the Salmon River such that the Snake River temperature always facilitated migration and the latter remained relatively constant throughout the migration period.

We used the University of Idaho IBM computer and the Statistical Analysis System (SAS) (S.A.S. Institute 1979) stepwise multiple regression procedure to select the best multiple variable models for predicting migration rate. Selection of the best models was based on the coefficient of determination (R') which represents the percentage of the variation in the dependent variable, migration rate, which can be attributed to variation in the independent (environmental) variables.

This procedure selected discharge as the single most important variable in determining migration rate from hatcheries to Whitebird, but the coefficient of determination for the single variable model was low (R^2 = 0.58). When the procedure considered two variable models, it selected velocity and transparency as the most important variables and left out discharge, which is a correlate of velocity. The R^2 for this model was a near perfect 0.98, thus no further variables were considered. The most useful model for predicting migration rate between hatcheries and Whitebird (based on available data) is as follows:

$$\text{Miles/day} = 18.14\ V + 9.52\ S - 101.76 \qquad R^2 = 0.98$$

When V = river velocity in feet per second
S = Secchi disc transparency in meters

As would be expected, the farther smolts migrated, the longer the travel time, but the relation was not directly proportional (Table 8).

Whitebird to Red Wolf

A major project objective was to document the arrival time of branded smolts at the head of Lower Granite Reservoir, but the Red Wolf trap was not effective in providing the needed information. However, the four branded chinook groups seen at Whitebird were also monitored at Lower Granite Dam as were the branded smolts we released at Whitebird. Because of this, we were able to use an indirect method to estimate arrival time at Red Wolf. The National Marine Fisheries Service released branded smolts at two-day intervals at Wilma, WA, less than one mile downstream from the Red Wolf trap, in order to estimate the efficiency of the Lower Granite Dam smolt bypass facility. Recapture of these smolts at Lower Granite Dam also provided information on travel time from the head of Lower Granite Reservoir to the Dam (Table 9). We used the NMFS data on median arrival time at Lower Granite Dam of Salmon River origin branded smolts to subtract travel time from Wilma to Lower Granite Dam from the travel time from Whitebird to Lower Granite Dam.

Travel time for the 105 mile migration ranged from 3 to 15 days with a general trend of increased rate as the season progresses (Fig. 9). Median arrival time of the four hatchery chinook branded groups ranged from April 18 to May 4 for Pahsimeroi River and South Fork Salmon River chinook smolts, respectively. The migration from the most distant point to Lower Granite Reservoir, i.e., Decker Flats, 437 miles upstream from Red Wolf, was 34 days, an average of 12.9 miles per day (Table 10).

Three regression analyses were done for migrants between Whitebird and Red Wolf, once for the four groups of branded hatchery chinook (a), once for nine of the "R" branded groups from Whitebird (b) and a third time for both groups a and b combined (c). Only nine of the "R" branded groups were used as no independent variable data from the Salmon River were available after May 24. Regression results are contradictory as can be seen in the following three equations. The best two variable models for equation a and c and four variable models for equation b were selected as further addition of variables made very little improvement in R2.

(a) $Y = 70.09\ DL - 21.94T - 766.95 \quad R^2 = 0.97$
(b) $Y = 12.86\ DL - 2.13\ SmnQ - 3.27T - 25.16S - 82.5 \quad R^2 = 0.77$
(c) $Y = 15.57\ DL - 1.51T - 182.35 \quad R^2 = 0.36$

Where Y = migration rate in miles per day between Whitebird and Red Wolf and the other variables are as described above.

Day length and Salmon River temperature appear in all three equations. Snake River discharge never appears and Salmon River discharge is not always present. In the spring of 1983, when discharge was always abundant, changes in discharge within the observed range had no major effect on migration rate. In low flow years such as 1977 we might expect to see discharge play a major

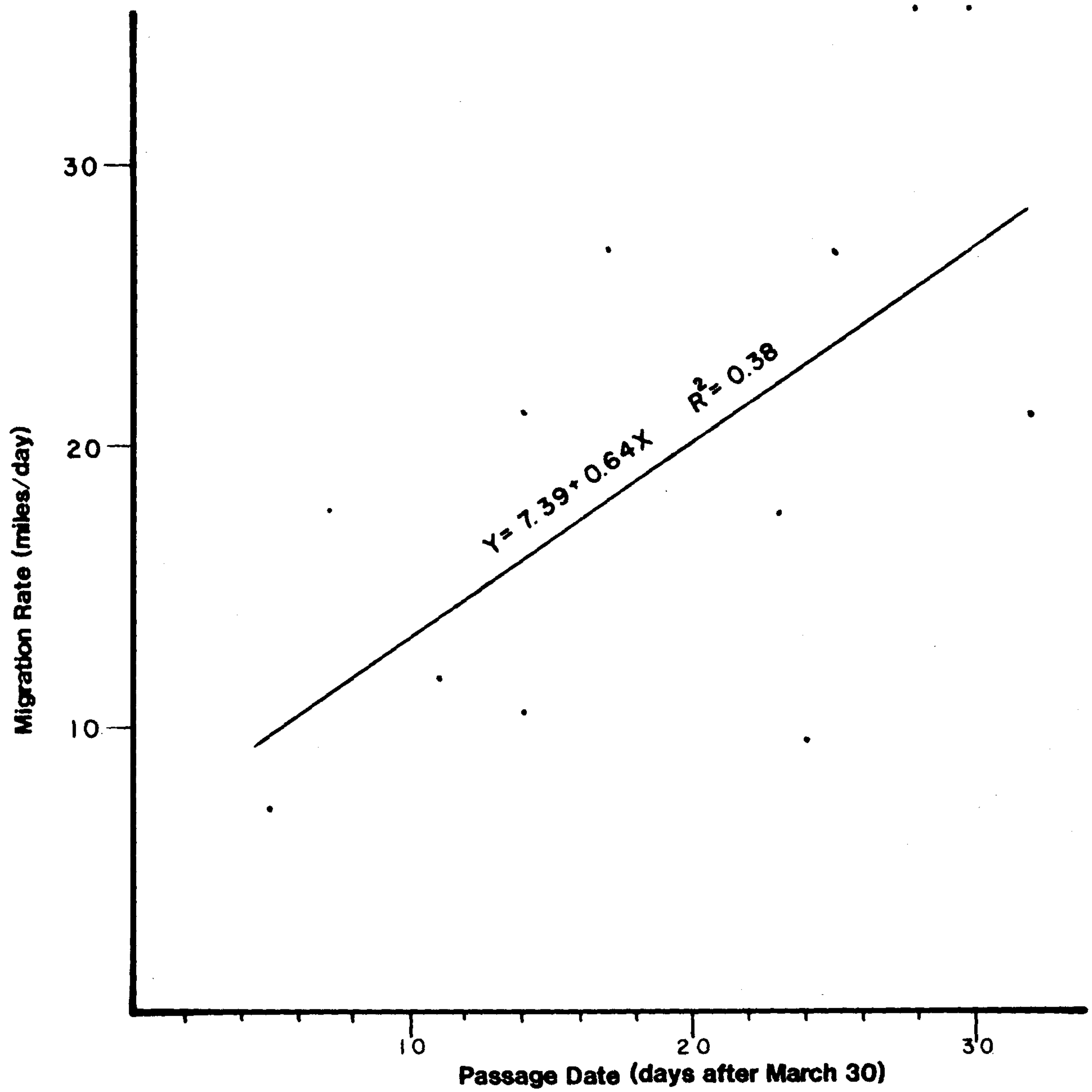


Figure 9. Relation between the date chinook smolts passed Whitebird and their migration rate between Whitebird and Red Wolf trap, 1983.

Table 8. Statistics of the chinook outmigration from release sites to Whitebird.

Species	Release site	Dates Release	Dates Arrival	Miles	Days	Migration rate	# brands observed
Chinook	S. Fk. Salmon	4/5	4/23	154	18	8.53 mi/day	134
	Decker Flats	3/29	4/29	331	31	10.68 mi/day	57
	Rapid River	3/25	4/4	40	9	4.44 mi/day	149
	Pahsimeroi	3/10	4/13	251	34	7.38 mi/day	124

Table 9. Median travel time for branded smolts migrating through Lower Granite Reservoir (Wilma, WA to Lower Granite Dam) during the spring of 1983. Data courtesy of NMFS.

Release date at Wilma, WA	Median travel time (days) to Lower Granite Dam
4/12	7
4/14	7
4/18	5
4/20	5
4/22	4
4/26	4
4/28	5
4/30	4
5/2	4
5/4	3
5/6	4

Table 10. Migration statistics for smolts traveling between release sites and Lower Granite Reservoir.

Brand	Release site	Date of release	Date of arrival	Travel time	Distance (miles)	Miles/day
RDT-1	South Fk. Salmon R.	4/5	5/4	29	260	9.0
RDT-2	Decker Flats, Salmon R.	3/29	5/2	34	437	12.9
RD12-1	Rapid R. Hatchery	3/26	4/19	24	145	6.0
LDT-4	Pahsimeroi R.	3/10	4/18	38	357	9.4

role in determining migration rate (Figs. 10 and 11). Obviously, it would be a year such as 1977 when judicious use of the water budget would be most important.

Somewhat disconcerting is the R^2 of equation c, indicating that more data did not improve on equations a or b, but simply added more variation.

Clearwater River Hatcheries to Red Wolf

Three branded chinook smolt groups from Kooskia NFH {82 miles above Red Wolf), one group of branded chinook smolts from Dworshak NFH (44 miles above Red Wolf) and four groups of branded steelhead from Dworshak NFH were monitored at Lower Granite Dam (Table 11). By again using the NMFS's Wilma to Lower Granite Dam travel time data, we estimated arrival time and migration rate for Clearwater River smolts between release sites and Red Wolf trap. Travel time for each of the three Kooskia chinook groups was 15 days, or 5.4 miles/day. Travel times for Dworshak smolts varied greatly. Chinook required 18 days while steelhead ranged from 2 to 12 days (Table 11). On a mile per day basis, steelhead were generally faster migrators than chinook. However, most steelhead were released in May whereas chinook generally were released in April. Discharge, temperature and turbidity are higher in May, all factors which would probably increase migration rate.

Migration rate for all eight groups were used in a single stepwise regression procedure to determine which factors influence migration rate. Since we did not sample the Clearwater River daily this spring, the only independent variables available are Clearwater discharge at the Spaulding gage and average day length. The regression procedure selected discharge as the more important of the two factors and determined that addition of day length to the model would provide no significant increase in R^2. Thus, our most appropriate model for estimating migration rate in the Clearwater River is as follows:

$$Y = 0.637Q - 2.511 \qquad R^2 = 0.58$$

Where Y = rate of migration in miles/day
Q = average daily Clearwater River discharge at Spaulding in thousands of cfs

This relation is graphically presented in Figure 12.

The Clearwater River watershed experienced a less than average snowpack during the winter preceding the 1983 smolt out-migration. In contrast, the Salmon and upper Snake River watersheds experienced significantly greater than normal snowfall. This difference may have affected the degree to which daily changes in discharge influenced smolt migration (Fig. 13).

Hopefully, the above types of analyses, when carried out with data from a series of years, where different hydrological cycles prevail, will provide adequate predictive ability relative to travel time and need for assistance from the water budget allowance.

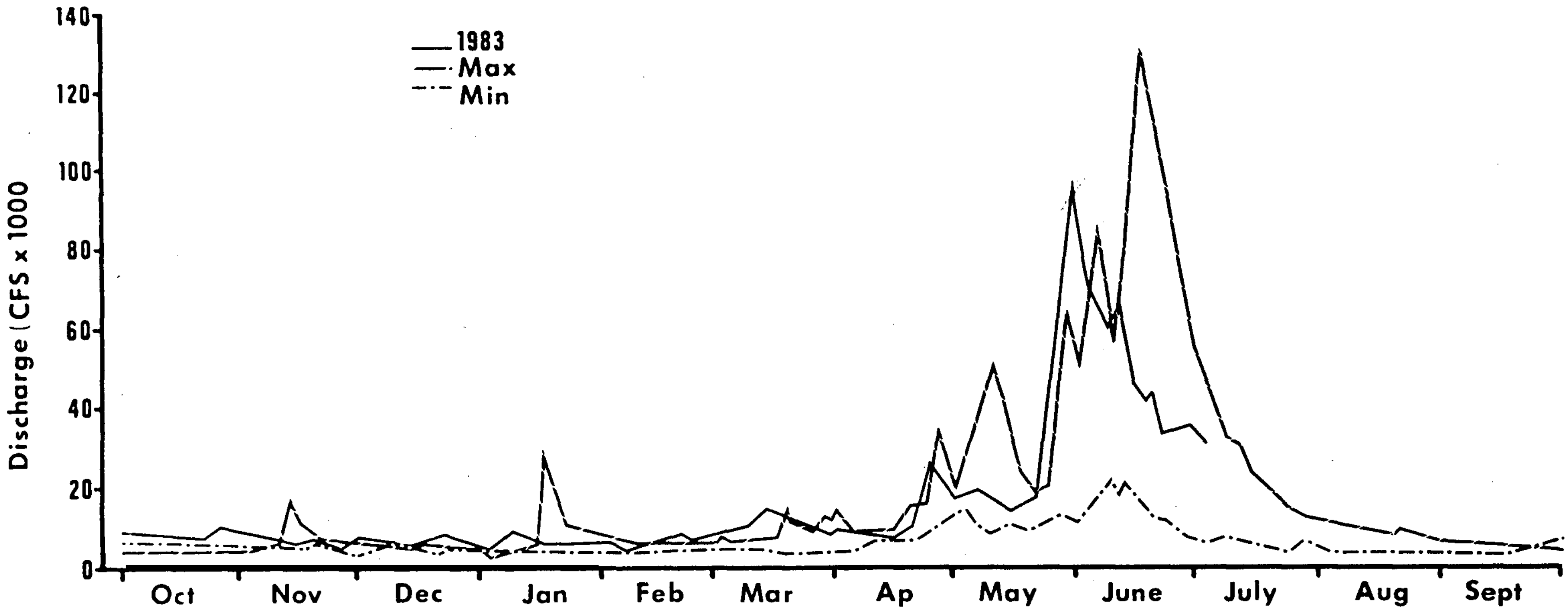


Figure 10. Maximum, minimum and 1983 discharge at Whitebird gage, Idaho for previous 10-year period of record.

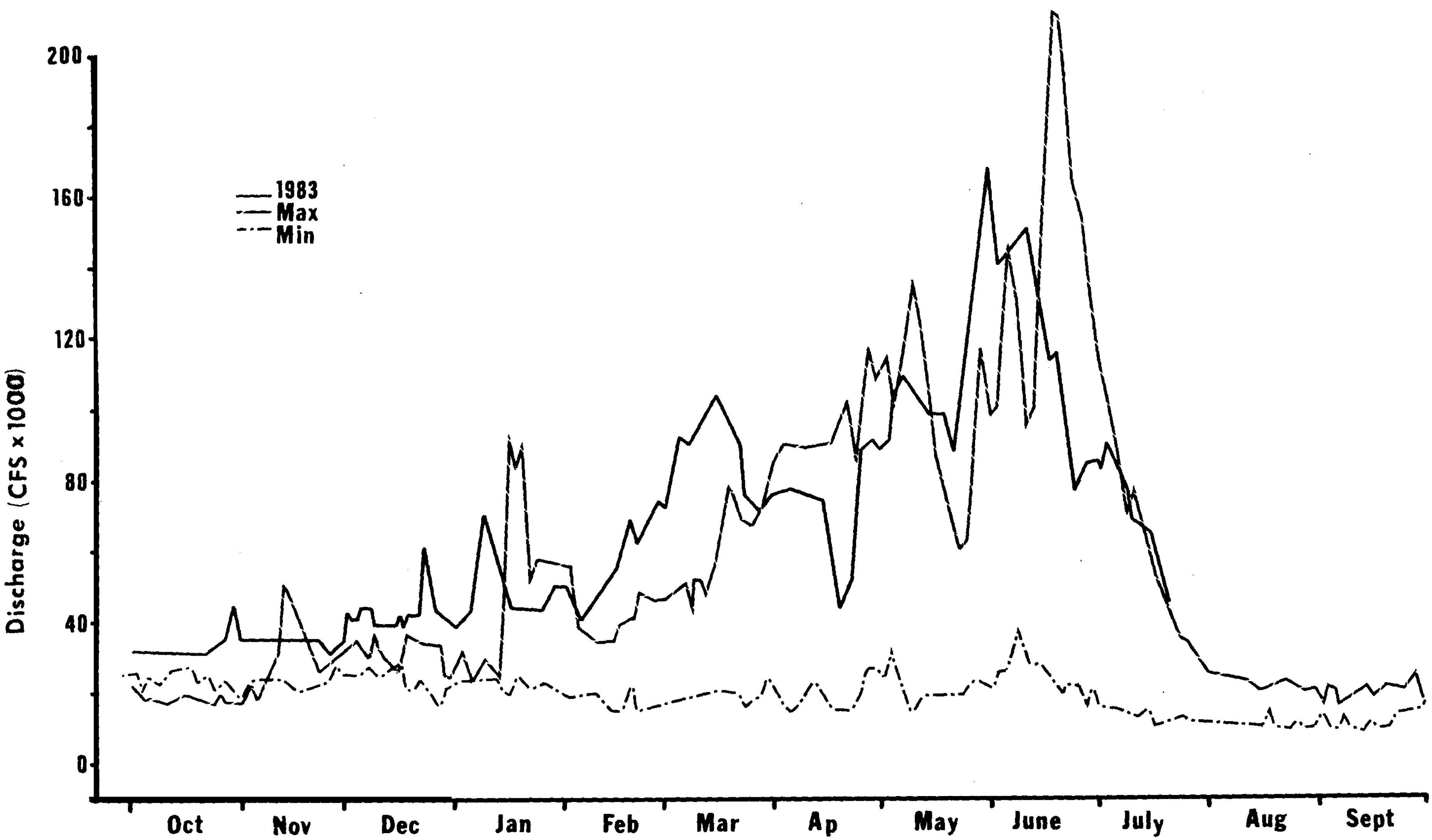


Figure 11. Maximum, minimum and 1983 discharge for the Snake River at Anatone gage from previous 10-year period of record.

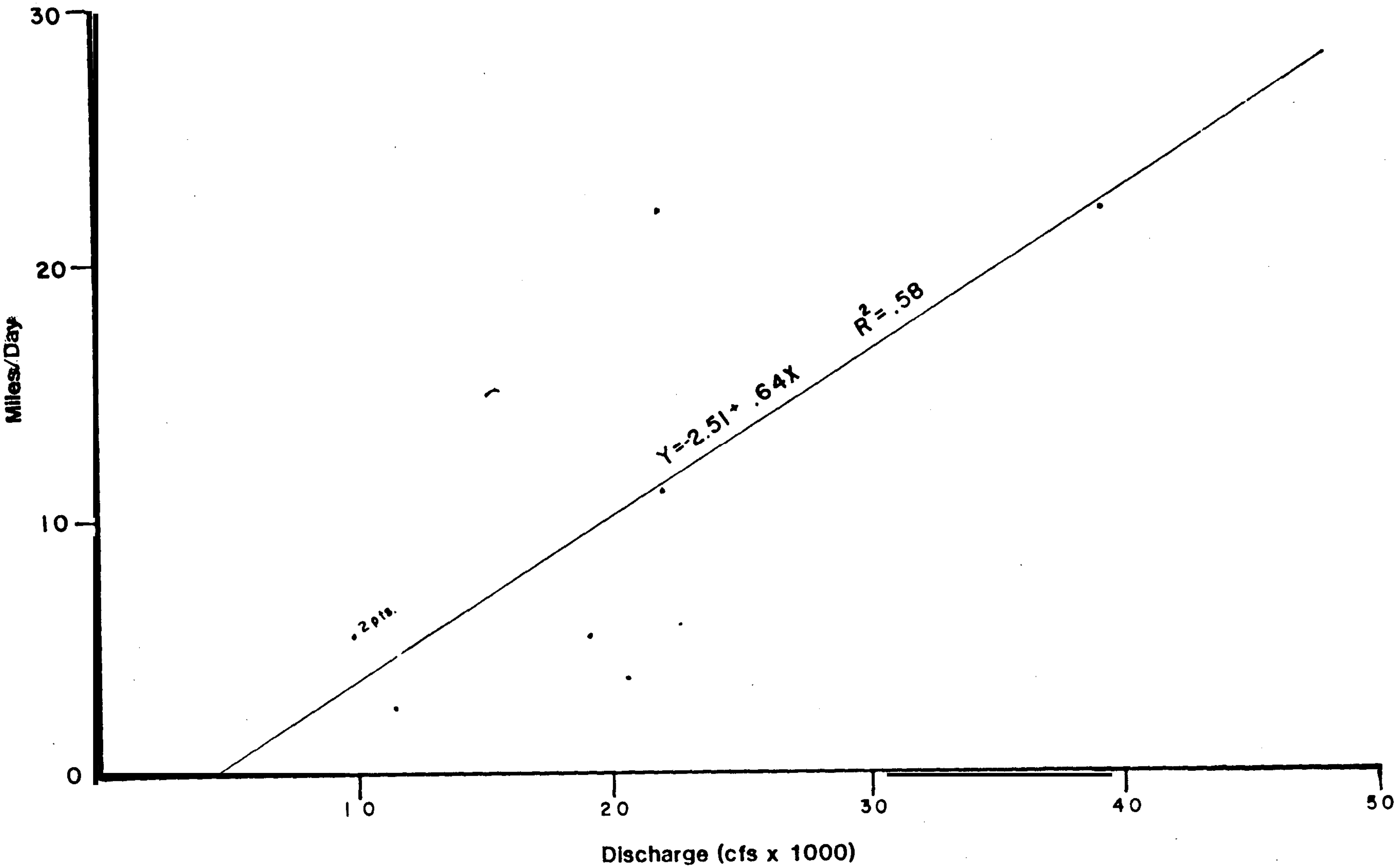


Figure 12. Relation between average Clearwater River discharge and migration rate (miles/day) for chinook and steelhead smolts traveling from Clearwater River release sites to Red Wolf trap, 1983.

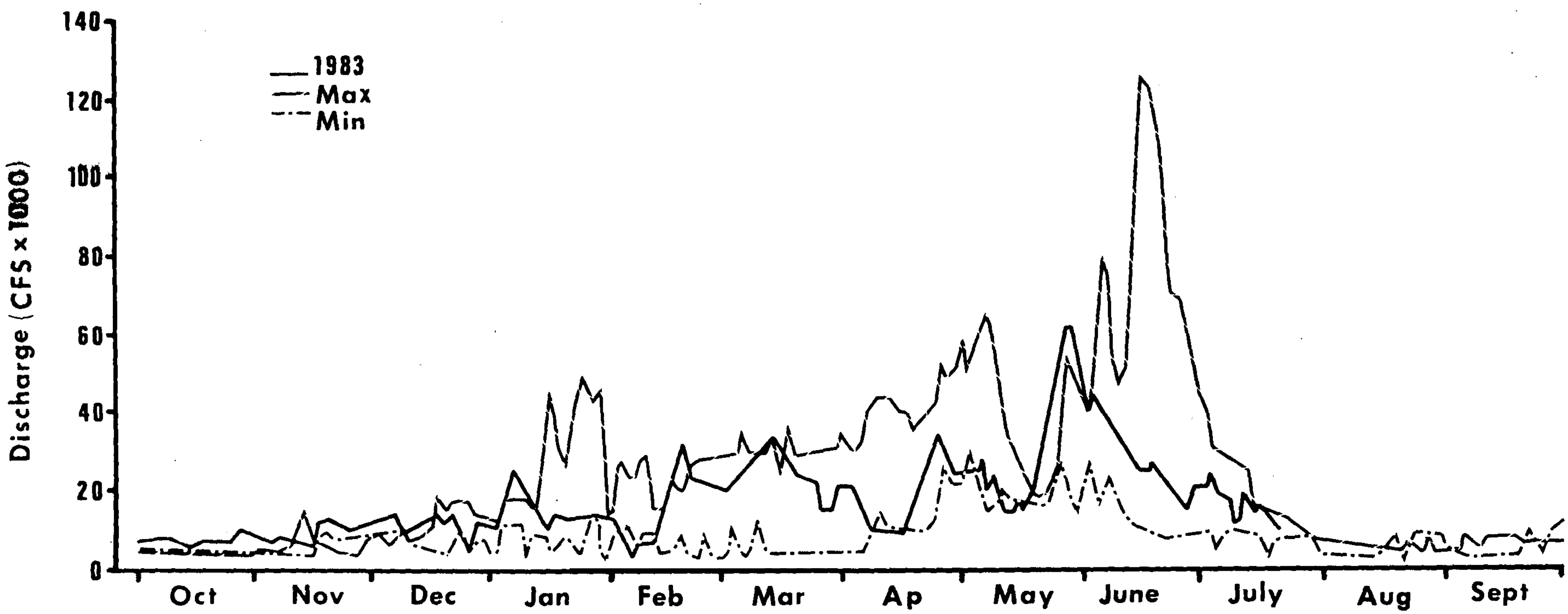


Figure 13. Maximum and minimum discharge since completion of Dworshak Dam (1972) and 1983 discharge for the Clearwater River at Spaulding, Idaho.

Table 11. Clearwater River hatchery releases of branded smolts and statistics of travel time and migration rate to Lower Granite Reservoir.

Brand	Species	Release site	Dates Release	Dates Arrival	Travel time (days)	Migration rates	# sampled at LG Dam
RAT-1	Sp. Ch.	Kooskia	4/8	4/23	15	5.4	176
RAT-2	Sp. Ch.	Kooskia	4/8	4/23	15	5.4	104
LOT-1	Sp. Ch.	Kooskia	6/14	6/29	15	5.4	29
RDU-3	Sp. Ch.	Dworshak at N.F. Clearwater	4/1	4/19	18	2.5	335
RAF-3	SH	Dworshak at N.F. Clearwater	5/3	5/7	4	11.0	956
RAF-4	SH	Clearwater	5/25	5/27	2	22.0	435
LAW-1	SH	Clearwater	4/20	5/2	12	3.7	852
LAW-2	SH	Clearwater	5/3	5/5	2	22.0	806

Efficiency of Whitebird Scoop Trap

From 1966 to 1968 NMFS made 55 releases of marked smolts upstream from the Whitebird scoop trap (NP7SS, unpublished data) as a means of estimating the fraction of smolts .which pass the trap that are captured. Most of these tests were done-when the river discharge was between 4,750 and 10,000 cfs, with only 7 tests conducted at discharges between 10,000 and 20,000 cfs. We made four efficiency tests in 1983, all of which occurred when discharge was between 16,000 and 22,000 cfs.

We used the linear regression procedure on the combined data of NMFS and that which we collected in 1983 to derive an equation for predicting trap efficiency based on river discharge. We attempted to improve the fit of the data to a straight line by using the logarithm of one variable at a time and then of both the discharge and efficiency variables. The equation with the best fit, however, required no transformation of the data (Fig. 14). Average values of discharge and efficiency were used for each 500 cfs interval of discharge:

$$\% \text{ Efficiency} = 2.825 - .121\,(D)$$

$R^2 = 0.52$
Where D = discharge in 1,000 cfs

Trap efficiency is a function of discharge and efficiency changes through the outmigration season, generally decreasing with increasing discharge. Because of this, estimates of relative abundance of fish passing the Whitebird trap or of the number of brands passing the trap on a given day are not only dependent on the number of fish captured in the trap, but also on the efficiency of the trap. Thus, best estimates of smolt passage, survival, travel time and migration rate are dependent on a consistent level of effort and on accurate estimates of both catch and trapping efficiency.

Retention of Smolts in the Scoop Trap

Loss of smolts from the scoop trap live well was suspected as increased river discharge caused surging of water with subsequent spillage of water from the live well. We put dyed smolts in the live well after the AM sample and removed them during the PM sample to estimate retention rate of smolts. Two smolt retention tests were done when discharges were 18,900 and 24,000 cfs. Smolt retentions were 58% and 46%, respectively. We will have to inhibit smolt loss in future years by modification of the live well.

Smolt Survival from Whitebird to Lower Granite Dam

Smolts branded at Whitebird had to migrate through approximately 100 miles of flowing river and 35 miles of reservoir before reaching Lower Granite Dam. Overall survival was 57% for chinook and 40% for steelhead smolts. Ninety-five percent confidence limits around these estimates are ±16% and ±26% for chinook and steelhead, respectively. These limits were calculated from series of survival estimates from unique brand groups released within consecutive three day intervals (Table 12).-Esti-0mates were weighted by sample size and we used only those groups from which brands were recovered at Lower Granite Dam, i.e., 12 groups for chinook and 10 groups for steelhead.

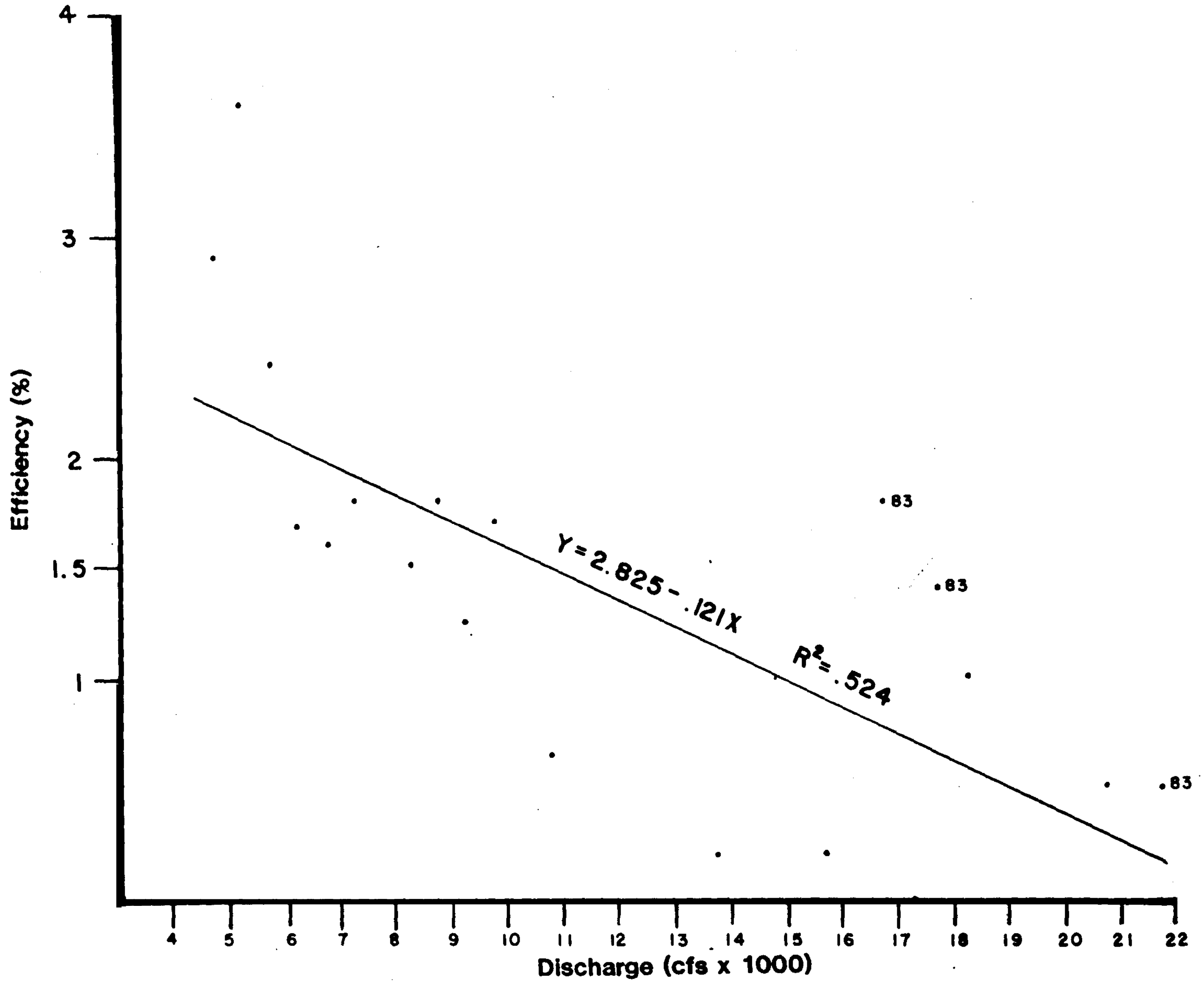


Figure 14. Relation between Salmon River discharge and percent trapping efficiency at Whitebird trap. Points indicated by "83" were determined from data collected in 1983. Other points were determined by the National Marine Fisheries Service in previous years.

Table 12. Statistics of smolts branded at the Whitebird scoop trap and recaptured at Lower Granite Dam, including weighted mean survival (X), standard deviation of the mean SX, 95% confidence units (CLS) and sample size (n).

Branding dates	Brand	Chinook No. branded	Chinook Est. no. passing L. Granite Dam	Chinook Est. survival	Steel head No. branded	Steel head Est. no. passing L. Granite Dam	Steel head Est. survival
4/6-4/8	RDR-1	1881	1713	91.1			
4/9-4/11	RDR-2	2938	2615	89.0			
4/12-4/14	RDR-3	3014	1729	57.4			
4/15-4/17	RDR-4	2348	1522	64.8			
4/18-4/20	LDR-1	1221	456	37.3	4	0	
4/21-4/23	LDR-2	3004	652	21.7	10	0	
4/24-4/26	LDR-3	402	219	54.5	106	99	93.4
4/27-4/29	LDR-4	512	295	57.6	348	122	35.1
4/30-5/2	RAR-1	637	157	24.6	88	54	61.4
5/3-5/5	RAR-2	582	160	27.5	141	72	51.1
5/6-5/8	RAR-3	287	74	25.8	379	74	19.5
5/9-5/11	RAR-4	167	108	64.7	278	57	20.5
5/12-5/14	LAR-1	42	0	-	138	34	.6
5/15-5/17	LAR-2	123 .	0	-	195	255	130.8
5/18-5/20	LAR-3	68	0	-	138	87	63.0
5/21-5/24	LAR-4	68	0	-	299	29	9.7
		17096	9700		2232	883	

	Chinook	Steel head
	X = 56.7	X = 41.0
	Sx = 7.4	Si = 11.6
	CLS = ±16.3	CLS .= 26.1
	n = 12	n = 10

$\frac{9700}{17096}$ - 56.7% survival

$\frac{883}{2232}$ = 39.6% survival

Raymond (1979) reported that prior to construction of dams in the Snake River above Ice Harbor, 89% of wild juvenile chinook from the Salmon River survived to Ice Harbor Dam. Survival of juvenile chinook this spring from the lower Salmon River to Lower Granite Dam was considerably less (57%) even though the distance to Lower Granite Dam is much less than to Ice Harbor Dam. The large percentage of the chinook run which is now reared under artificial conditions probably contributed to this difference.

Descaling

Descaling at Hatcheries

Chinook were sampled at Dworshak NFH, Kooskia NFH, Hagerman NFH, Pahsimeroi, McCall and Rapid River hatcheries (Table 13). With few exceptions, chinook were in good condition. Percent classical descaling ranged from 0.0-7.4% among all samples taken. Maximum descaling occurred at Dworshak NFH on a test group of Little White Salmon River egg stock, raised at 8.0°C. Smolts raised from the same egg stock, but at 12°C, also exhibited high descaling (2.5%). Chinook at all hatcheries reared at the usual temperatures of 4.5-5.0°C showed little descaling (<1.0%). Kooskia NFH showed greater descaling in test groups of higher density raceways, as well as marked smolts in marked vs. unmarked comparisons. At all hatcheries, scattered descaling ranged from 0.0-22.1%. The Dworshak NFH chinook that showed the greatest classical descaling also exhibited the greatest scattering. The 8°C and 12°C test groups at Dworshak NFH had 17.6% and 22.1% scattering, respectively. A large amount of scattering also occurred in the high density raceways (10.6 and 11.8%) at Kooskia NFH. Eye and head injuries were usually in the form of bugeye (BKD) and short opercles. Chinook had eye and head injuries ranging from 0.0-2.5%. Other descaling damage (0.0-21.5%) included damage that was not considered as classically descaled or scattered, i.e., only one area descaled, or one area on each side descaled. Spring chinook mean total lengths ranged from 110.0-184.0 mm.

The only fall chinook sampled were at Hagerman NFH. They exhibited no classical descaling, 0.7% scattered descaling and had 1.0% eye and head injuries. These smolts had a mean total length of 109 mm.

Steelhead were sampled at Dworshak NFH, Magic Valley Steelhead, Hagerman NFH and Niagara Springs Hatchery. They were generally in good condition with classical descaling in the range of 0.0-3.0%. The highest percent of descaled steelhead (2.7 and 3.0%) occurred in Systems 2 and 3 at Dworshak NFH. Other steelhead hatcheries had a maximum descaling of 0.3%. Scattered descaling ranged from 0.8-49.3%. As in chinook, those steelhead that exhibited higher classical descaling also exhibited a higher degree of scattered descaling (maximums in Systems 2 and 3, Dworshak). Eye and head injuries in steelhead ranged from 0.0-24.0%. Twenty-four percent was unusually high and was the result of short opercles. These were found in the one group of steelhead sampled at Dworshak NFH (System 3) that also showed the highest percentage of classical descaling and scattered descaling. Other descaling damage had a maximum of 6.0%. Mean total lengths of steelhead ranged from 184.6 mm-281.0 mm.

Table 13. Condition of fish sampled at hatcheries, 1983.

Date Sampled 1983	Hatchery	Raceway	Species	Tot.# fish sampled	Tot.% fish descaled	Mean length (mm)	Standard deviation	Additional information
3-28	Dworshak	B16-18	Chinook	300	0.33	167.1	38.6	Rapid R. egg stock; T=4.5°; Bimodal length dist.
3-28	Dworshak	B20-22 A3,6,8,12	Chinook	300	0.00	176.8	40.3	Little White Salmon R. egg stock; T= 4.5°; Bimodal length dist.
3-28	Dworshak	B19	Chinook	3 68	0.00	177.4	37.4	U of I test spawn; T=4.5°; Bimodal len2th dist.
3-29	Dworshak		Chinook	148	7.40	174.5	48.5	Little White Salmon R. egg stock; T=8.0°; Bimodal length dist.; 19% scattered descaling; 12.2% other descaling; 6.7% dorsal splits; 2.0% eye/head injury
3-29	Dworshak		Chinook	158	2.50	184.0	48.8	Little White Salmon R. egg stock; T=12.0°; Bimodal length dist. 22.1% scattered descaling, 21.5% other scaling damage, 2.5% eye/head injury
5-2	Dworshak (System 2)	22,24,36 44,46,48	Steelhead	300	2.70	185.8	35.2	28% scattered descaling; 7% short opercles; 6% other damage; T.7% fungus
5-2	Dworshak (System 3)	7U,72,T6 78,80,82	Steelhead		3.00	184.6	35.1	49.3% scattered descaling; 24% short opercles; 4% other descaling damage
5-9	Dworshak – (System 3)	52,51-67, 54-68, 8-20	Steelhead	600	0.70	186.1	33.9	33.3% scattered descaling, 7.3% short opercles; 5.4% other descaling damage; 0.8% fungus
5-16	Dworshak (System 3)	31,33,39 41,45,47,39	Steelhead	300	0.70	201.2	30.8	28% scattered descaling; 3% other descaling damage
5-3	Dworshak; Clearwater R. (below release pipe)		Steelhead	100	0.00	192.9	19.6	14% scattered descaling; 6% other descaling; good shape overall
4-16	Crystal Springs	16,26,3A, 4A,6A	Steelhead(B)	305	0.00	*221.0		Mean weight-105 gm; T=14.4°C; 3.3% scattered descaling; no other damage; raceways 1& 2 also sampled 5/1/83

Table 13. Continued.

Date Sampled 1983	Hatchery	Raceway #	Species	Tot.# fish sampled	Tot.% fish descaled	Mean length (mm)	Standard deviation	Additional information
4-16	Crystal Springs	5,6	Steelhead	333	0.30	*235.0		Mean weight-125 gm; T=14.4°C; 4.8% scattered; 0.9% other descaling; released Pahsimeroi 4/18
5-1	Crystal Springs	1,2, B,C,D,	Steelhead(B)	214	0.00	*221.5		Mean weight-105 gm; T=14.4°C; 21.0% scattered, 0.9% other descaling
5-1	Crystal Springs	1A,2A	Steelhead(B)	110	0.00	*221.5		Mean weight-105 gm; T=14.4°C; 14.5% scattered; no other descaling damage
3-31	Kooskia	12	Chinook	297	0.70	136.9	27.4	High density unmarked (30,000/raceway); T=5°C; 11.8% scattered; 0.3% other descaling
3-31	Kooskia	1	Chinook	358	0.30	143.9	16.2	High density marked (RAT-1 30,000/raceway); T=5°C; 10.6% scattered; 0.8% other descaling; 1.7% head injury
3-31	Kooskia	3	Chinook	300	0.30	158.3	22.0	Low density marked (RAT-2 8000/raceway); T=5°C; 6.3% scattered; 0.7% other descaling; 1.7% head injury
3-31	Kooskia	5,6,8, 9,10,11	Chinook	314	0.30	143.7	16.8	Medium density unmarked (15,000/raceway); T=5°C; 5.0% scattered; 1.3% other; 1.3% head injury
3-29	Hagerman NFH	55	Steelhead(A)	152	0.00	*248.0		T=59°F (15°C) 1.9% scattered; only other damage L&R5=4.6%; mean weight-148.6 gm; Pahsimeroi eggs
3-29	Hagerman NFH	54	Steelhead(A)	150	0.00	*253.0		T=59°F; 2.0% scattered; no other descaling; mean weight-157.7 gm; Pahsimeroi egg stock
4-5	Hagerman NFH	19,20,61, 62	Steelhead(B)	300	0.33	*239.3		T=59°F; 6.7% scattered descaling in LR5; 1.0% head/eye injury; mean weight-124.8 gm; stocked E.F. Salmon on 4/16; Pahsimeroi egg stock

Table 13. Continued.

Date Sampled X983	Hatchery	Raceway #	Species	Tot. # fish sampled	Tot.% fish descaled	Mean Length (mm)	Standard deviation	Additional information
4-12	Hagerman NFH	13,14	Steelhead(B)	307	0.00	*237.0		T=59°F (15°C); 1.0= scattered descaling; 2.9% LR5 descaling; 1.9% eye/head injury; mean weight-129.5 gm; stocked E.F. Salmon 4/13; Pahsimeroi egg stock
4-19	Hagerman NFH	1,2	Steelhead(B)	123	0.00	*239.0		T=59°F (15oC); 1.6': scattered descaling; 1.6% LR5 descaling; 1.6% eye/head injury; mean weight-132.5 gm; stocked Decker Flat 4/21/83; Pahsimeroi egg stock
4-19	Hagerman NFH	34	Steelhead(B)	64	0.00	*206.0		T=59°F; 0.8% scattered descaling; mean weight-85 gm; stocked Decker Flat 4/20; Pahsimeroi eggs
4-19	Hagerman NFH	23,26	SteeThead(A-)	129	0.00	*110.0		T=-590x'; 0.8% scattered descaling; mean weight- 215 gm; released Decker Flat 4/20/83; Pahsimeroi egg stock
6-6	Hagerman NFH	40,41 42,43	Chinook	300	0.00	*110.0		T=590F; 1.7% head/eye injury; 0.3% area 5 descaling; mean weight-13 gm; Rapid R. egg stock; released Red River 6/7/83
6-13	Hagerman NFH	15-39	Chinook	300	0.00	*124.5		T=59u F; 1.7% head/eye injury; 0.3% area 2 descaling; mean weight-16.2 gm; Kooskia egg stock; released Kooskia (Clear Cr.) 6/13, 6/16
6-15	Hagerman NFH	8-12	Fall chinook	300	0.00	*109.2		T=59oF; 0.7% scattered; 1.0% eye/ head injuries; 0.3% area 4 descaling; mean weight-11.3 gm; Dworshak egg stock; released Grande Ronde 6/16
4-6	Niagara	3	Steel-head-(A)	100	0.00	*233.7		T=- 580F; 2.0%-eye/head injury; 1.0% area 4 descaling; released Pahsimeroi R.

Table 13. Continued.

Date Sampled 19BT	Hatcherv	Raceway N	Soecies	Tot.= fish samoled	Tot.% fish deccaled	Mean length (mml	Standard deviation	Additional infnrmatinn
4-11	Niagara	9	Steelhead(A)	100	0.00	*231.1		T=58⁰F; 1.0% area 3 descaling; 2.0% area 4; 2.0% area 5; released Pahsimeroi R.
4- 2	Niagara	8	Steelhead B	00	0.00	* '.. 4		T= 8⁰ ; .0% scattered desca ing; 1.0% area 2; 2.0% area 3, released E.F. Salmon R.
-	• Niagara Freeze:ran.ing STHD "A"	He s Canyon stock re ease• '/ 0/8 RD -' were in good con.ition with few •e ormities from HN. 3.25/lb; 3/19/83; 3.00/lb; 4/20/43 - released Hells Canyon. Pahsimeroi stock released 4/19/83 (LD12-4) had considerable deformities from IHN. 4.2/lb; 3/19/83; 3.4/lb; 4/19/83 - released Pahsimeroi R.						
3-10	Pahsimeroi		Chinook	150	-	5-inch smolts were collected below the ponds & six miles down-stream at trap and no sign of descaling observed		
3-14	Rapid River		Chinook	300	0.00			
3-17	Rapid River		Chinook	300	0.00			2.7% scattered
3-18	Rapid River		Chinook	150	0.00			4.7% scattered, released Hells Canyon
4-12	Raid River		Chinook	600	0.00			2.3% scattered
6	Ra.id River		Chinook	mi ion fish	x = . mm	He is anyon is	g = .' mm	
4- 8	Rapid River		Chinook	1.9 million fish	x = 130.0 mm TL	Rapid River	= 127.9 mm	

*Mean length calculated from number/lb.

Descaling at Release Sites

Fish were sampled at the release sites to determine if they incurred any additional descaling or degradation during transportation (Table 14). When possible, sampling was done in the river below the release point. Those samples-not taken in the river were taken directly from the transportation truck. Overall, little difference in condition for all species was seen between samples taken at the hatcheries and those at the release sites.

Chinook release locations included Kooskia raceways (trucked from Hagerman NFH), South Fork Clearwater and Red River (Hagerman NFH), Decker Flat and South Fork Salmon (McCall Hatchery), and Pahsimeroi River (Pahsimeroi Hatchery). Untransported chinook at Dworshak NFH and Kooskia NFH were not sampled at the time of release.

Descaled chinook ranged from 0.0-0.6% and maximum scattering was 28%. Dorsal, caudal and anal fin splits were observed to a maximum of 21%. Mean lengths ranged from 110.0-184.0 mm.

Hagerman NFH fall chinook released at the Grande Ronde River showed an increase in descaling from 0.0 to 1.5%. There was a dramatic increase in scattered descaling from 0.7 to 29.1%. The mean length was 106.4 mm.

Steelhead release locations included South Fork Clearwater (Dworshak NFH), East Fork Salmon, Decker Flat (Hagerman NFH) and the Pahsimeroi River (Niagara Springs Hatchery, Magic Valley Hatchery and Hagerman NFH). Descaling and scattering ranged from 0.0-4.2% and 0.3-29.0%, respectively. Other descaling was generally low with a maximum of 22.0% occurring at the South Fork Clearwater release (Dworshak NFH). Eye and head injuries had a 0.0-1.3% range. Mean lengths were 192.6-281.0 mm.

Descaling at Trapsites

Trend Through Time

Classical descaling, where two or more of the five areas on one side of a fish are descaled, was evaluated daily at the Whitebird and Red Wolf traps. We calculated the percent of sampled smolts that were descaled on a weekly basis to see if a trend in rate of descaling appeared as the season progressed (Figs. 15 and 16).

At.Whitebird, descaling of chinook was relatively low, remaining under 2% from mid-March until late April then rising to near 4% until the last week of sampling, when it rose to 10%. Thus, there was a general increase in descaling of chinook through the season. Wild steelhead were captured only during a four-week period beginning the last week in April. Descaling ranged from 1-5% with no obvious trend over time. Descaling of hatchery steelhead steadily increased from zero to 30% from mid-April through late May. The large difference in descaling between wild and hatchery steelhead at Whitebird leads to a conclusion that elevated descaling is associated with hatchery rearing or undergoing the loading and

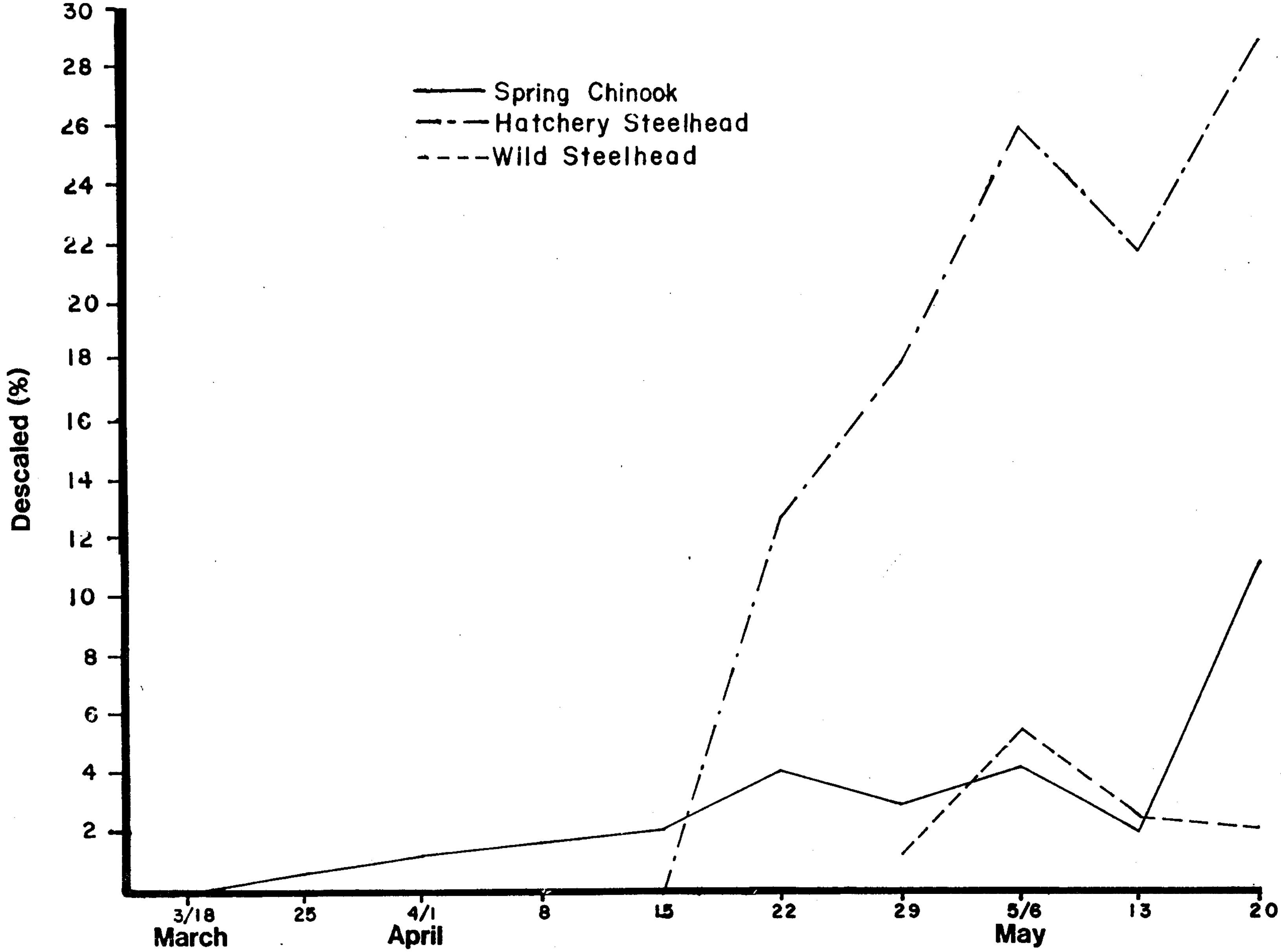


Figure 15. Percent descaling by weekly interval of hatchery and wild steelhead and chinook at the Whitebird scoop trap, 1983.

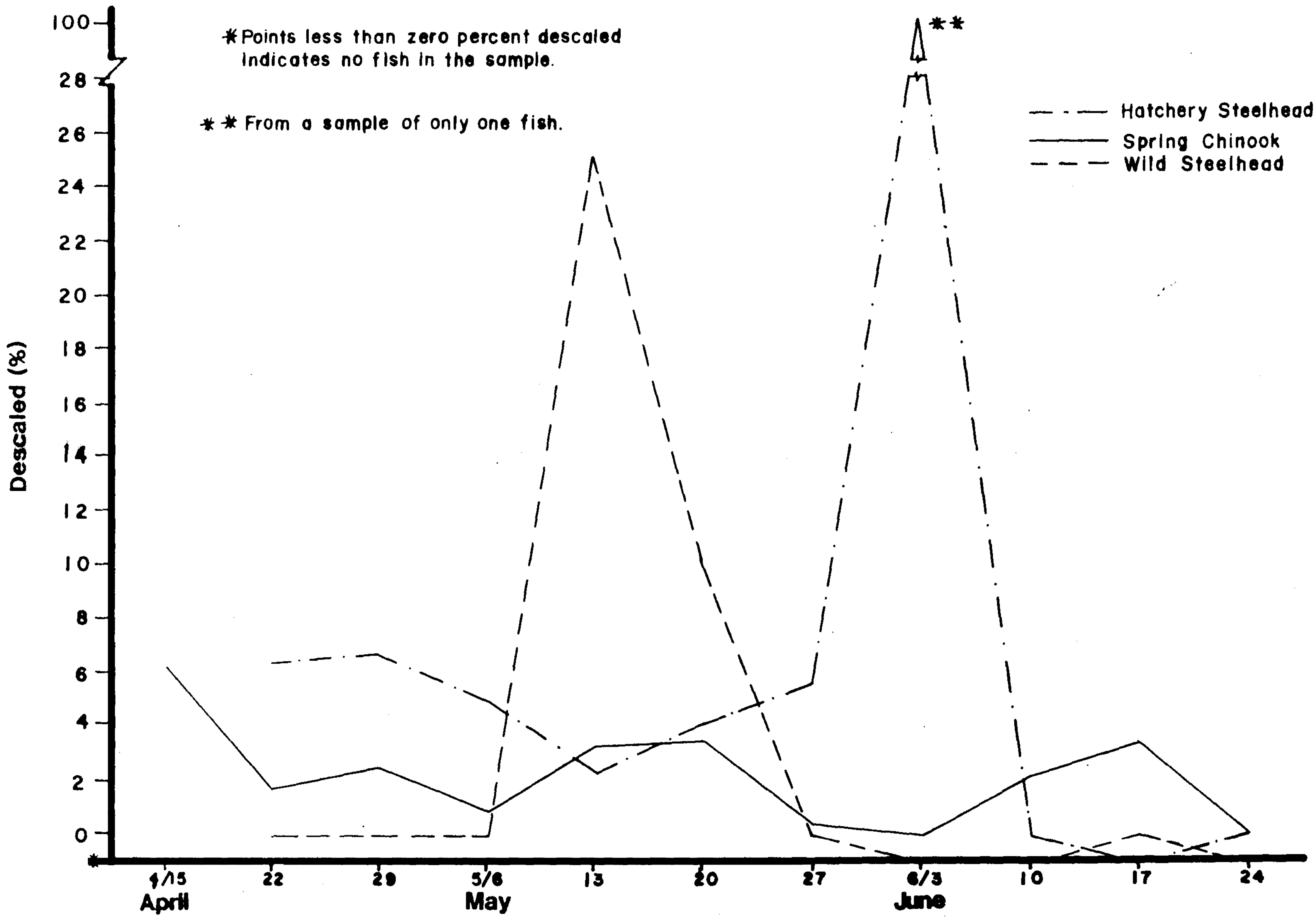


Figure 16. Percent descaling by weekly interval of hatchery and wild steelhead and chinook at the Red Wolf trap. Dates are week midpoints, 1983.

Table 14. Condition of fish sampled at hatcheries and release sites.

Date Sampled	Hatchery.	Sample location		Tot.# fish sampled	Tot.% fish descaled	Mean length (mm)	Standard deviation	
1983 5-10	Dworshak	S.F. Clearwater	Steel head	100	2.00	192.6	19.1	Fish from raceways 8-20 which were also sampled 5/9/83 at Dworshak. Fish sampled directly from transport truck release chute. 29% scattered; 22% other descaling; 4% fungus
6-13	Hagerman NFH	Kooskia raceway	Chinook	361	0.60	117.5	11.6	T=10^{0}C; 10% scattered; 1.1% other descaling; 5.0% dorsal split; 1.1% caudal; 0.6% anal; 2.8% head injury; Kooskia egg source; released Clear Cr.
6-16	Hagerman NFH	Kooskia raceway	Chinook	223	0.00	122.4	8.9	0+ spring chinook; all adipose clipped; 63 branded LDT-1 (28%); 21% caudal split; 9% dorsal; 2.2% scattered descaling; no other descaling; Kooskia egg source; released Clear Cr.
6-16	Hagerman NFH	Kooskia raceway	Chinook	201	0.00	117.2	13.0	0+ spring chinook; 1.5% scattered; 13.4% caudal split; 10% dorsal split; 2.0% anal split; 2 fish w/sunburn (1.0%); 1 fish w/fungus (0.5%); Kooskia egg source; released Clear Cr.
6-16	Hagerman NFH	Kooskia raceway	Chinook	210	0.00	112.2	14.0	0+ spring chinook; 58 branded LDR-1 (27.6%); 0.5% scattered descaling; 14.3% caudal split; Kooskia egg source; released Clear Cr.
6-7	Hagerman NFH	S.F. Clearwater & Red River	Chinook	222	0.00	110.2	10.8	28% scattered descaling; 4.5% other descaling; 2.2% caudal split; 0.5% fungus; Raid River egg source
	Hagerman	Grande Ronde	Fall chinook	196	1.50	106.4	18.7	Sampled directly from transport truck; 29.1% scattered descaling; 1.0% other descaling; 6.6% dorsal split; 5.1% caudal split; 7.6% anal split; Dworshak egg stock

Table 14. Continued.

Date Sampled 1983	Hatchery	Sample location	Species	Tot.# fish	Tot.% fish descaled	Mean length (mm)	Standard deviation	Additional information
4-6	Hagerman NFH	E.F. Salmon	Steelhead(B)	308	0.00	*236.0	3.6	Sampled directly from 2 transport trucks; T=49°F; 3.2% scattered; 0.3% eye/head; 0.3% LR4; 0.3% dead; mean weight-127 gm; same group fish sampled at Hagerman 4/5/83; Pahsimeroi egg_ source
4-13	Hagerman NFH	E.F. Salmon	Steelhead(B)	304	0.00	*237.0	3.5	Sampled directly from 2 transport trucks; T=48°F truck; T=44°F river; 0.3% scattered; 1.0% eye/head injury; 0.3% dead; mean weight-129.5 gm; Pahsimeroi egg stock
4-20	Hagerman NFH	Decker Flat, Salmon R.	Steelhead(A)	158	0.00	*281,0	2.1	Sampled directly from truck; T=49°F; pump related injuries 1.0%; 1.9% scattered descaling; 1.3% head/eye injury; 4.4% dead; mean weight-215 gm; Pahsimeroi egg stock
4-20	Hagerman NFH	Decker Flat, Salmon R.	Steelhead(A&B)	148	0.00	*110.0		Sampled directly from truck; T=50°F; 2.7% scattered; mean weight-101 gm; Pahsimeroi eggs
3-28 3-29 3-30	Hagerman NFH	Pahsimeroi R. (3 releases)	Steelhead(A)	37 6	1.10	*247.0		T=45^0F; 5.0% scattered descaling; 3.7% other descaling; 0.6% eye/head injury; 0.3% dead; combined 3.4 & 2.7/ lb; sampled below tanker discharge
4-5	Niagara Springs	Pahsimeroi R.	Steelhead(A)	11 9	4.20	*220.0		Sampled below tanker discharge; T= 43^0F; 14.3% scattered; 2.5% other de-scaling; 0.8% eye/head injury
4-11	Niagara Springs	Pahsimeroi R.	Steelhead(A)	26 2	3.10	*233.0		Sampled below tanker discharge; T= 45^0F; 9.2% scattered descaling; 1.0% other descaling; 1.1% dead
4-21	Niagara Springs	Pahsimeroi R.	Steelhead(A)	21 6	0.00	*277.0		Sampled below tanker discharge; T= 52^0F; 1.8% scattered; 1.4% dead; 3.2% other descaling

Table 14. Continued.

Date Sampled 19R3	Hatchery	Sample location	Species	Tot.# fish sampled	Tot.% fish descaled	Mean length (mm)	Standard deviation	Additional information
4-22	Niagara Springs	Pahsimeroi R.	Steelhead(A)	293	0.30	*227.0		Sampled below tanker discharge; T= 52^{0}F; 3.4% scattered; 1.7% other descaling.
	Niagara Springs	Pahsimeroi R	Steelhead (A)	182	0.00	*241.0		Sampled below tanker discharge; T= 48^{0}F; 9.3% scattered; 1.1% eye/head injury ; 0.5% dead
5-	Niagara Springs	Pahsimeroi R	Steelhead (A)	182	0.80	*218.0		Sampled below tanker discharge T= 52^{0}F; 2.4% scattered
5-3	Niagara Springs	Pahsimeroi R.	Steelhead (A)	206	0.00	*218.0		Sampled below tanker discharge; 52^{0}F; 1.5% scattered; 2.4% other descaling
4-18	Crystal Springs	Pahsimeroi R.	Steelhead (A)	439	1.10	*233.0		Sampled below tanker •discharge; 52^{0}F; 12.3% scattered; 0.2% dead; all descaled areas were 4 & 5
-29	Mc Call	Decker Flat	Chinook	298		*124.0		30-35% of fish undersized (50-100 mm) other fish in good shape; small % dead
4-5	McCall	S. . Salmon R.	Summer Chinook	293				Released good shape & in presmolt stage; fewer pinheads than the spring chinook; 0.3°: scattered; 1.0% other; 0.7% dead; 0.3': eye/head injury

*Mean length calculated from number/lb.

transport to release site procedure. Unfortunately, so few branded steelhead were observed that we were unable to tell if some particular release groups suffered larger descaling rates than others.

At Red Wolf, descaling of chinook was generally below 4% with no observable trend in descaling over time. Wild steelhead were observed during seven weeks at Red Wolf. Descaling of wild steelhead was zero during five weeks but rose to 24% during mid-April. This large value may be an artifact of small sample size; we believe it overestimates descaling for wild steelhead. Descaling of hatchery steelhead was generally less than 7%, much less than at Whitebird. The peak which occurred during the first week was from a sample of one hatchery steelhead smolt and should be ignored when analyzing the trend in descaling. I see no obvious trends in descaling of any species at Red Wolf. The difference in descaling of hatchery steelhead between the Whitebird and Red Wolf traps indicates that either (1) the catch of hatchery steelhead at Red Wolf contained a large percent of Dworshak steelhead which had very low descaling rates, or (2) a large percent of the descaled hatchery steelhead as observed at Whitebird died before reaching Red Wolf. Based on sampling by NMFS at Lower Granite Dam, we estimate that 50-60% of steelhead smolts passing Whitebird died before reaching Lower Granite Dam. NMFS research, as reported by Basham et al. (1981) found that descaled smolts could be expected to suffer high rates of mortality.

<u>Descaling by Length Interval</u>

We separated the total season smolt sample for each species into 20 mm length intervals and calculated percent descaling independently for each length interval. We hoped to see if certain size groups of smolts suffered descaling more than others, possibly due to poor growth, which might be expected with smaller individuals, the difficulty in running very large individuals through a fish-loading pump, etc.

At Whitebird, chinook descaling remained low (1-4%) among smolts less than 160 mm, while larger chinook suffered 10-15% descaling (Fig. 17).

Wild steelhead showed a slow, steady increase in descaling as size increased. Although more variable, hatchery steelhead demonstrated a similar trend (Fig. 18). However, for the very large steelhead smolts, i.e., >260 mm, hatchery smolt descaling increased while wild steelhead descaling decreased.

There is some indication that "runts" suffer slightly higher rates of mortality than do average sized smolts as there are small peaks of descaling for 80-100 mm chinook and 140-160 mm hatchery steelhead. The elevated rate of descaling for large hatchery steelhead could be caused by injuries in a fish pump, the system used by most facilities which transport smolts to release sites.

At Red Wolf, descaling of chinook shows a generally stable rate at less than 2`% up through 140 mm, then increases to 15% for 161-180 mm

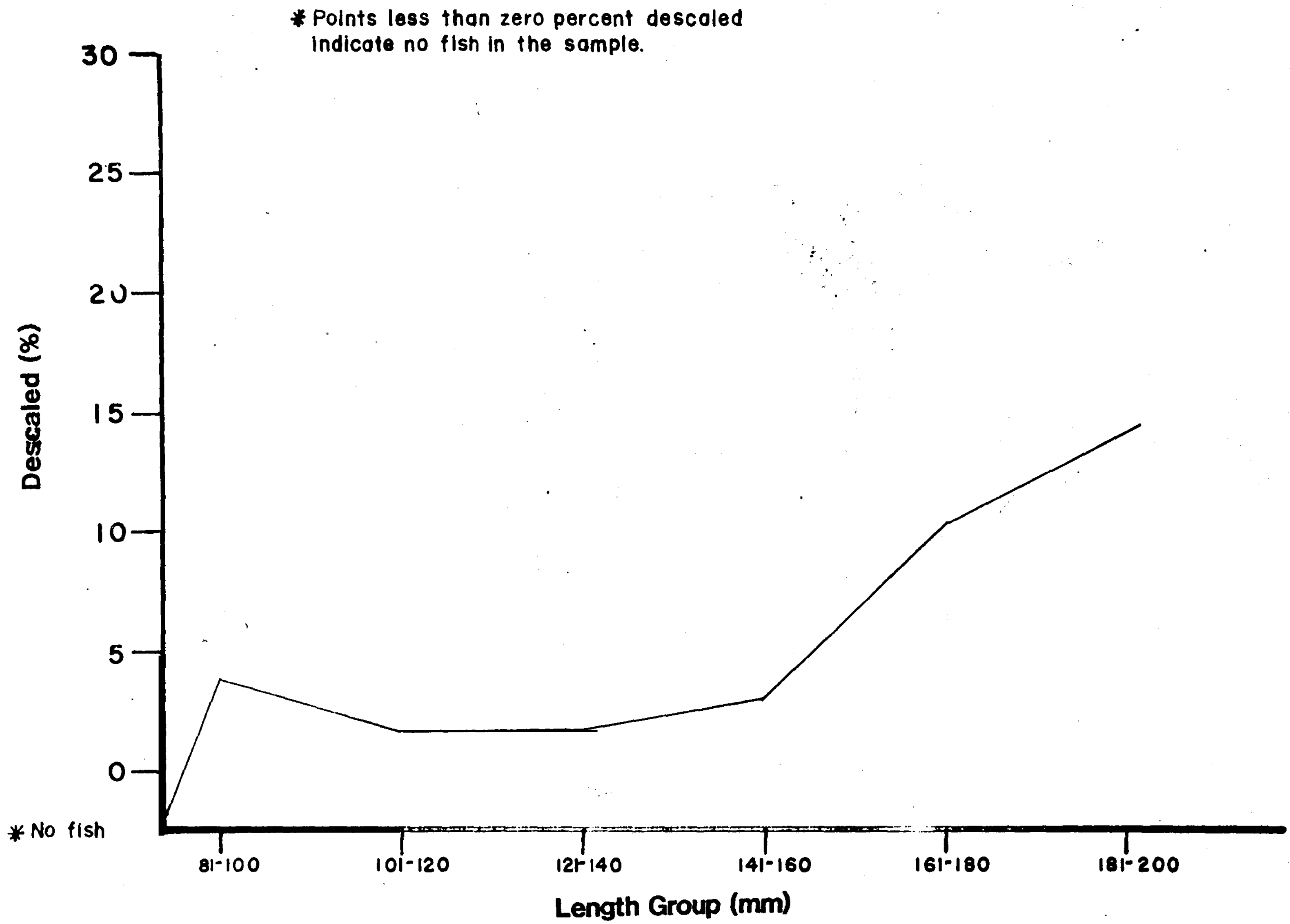


Figure 17. Percent descaling by 20 mm length intervals for juvenile chinook at the Whitebird scoop trap.

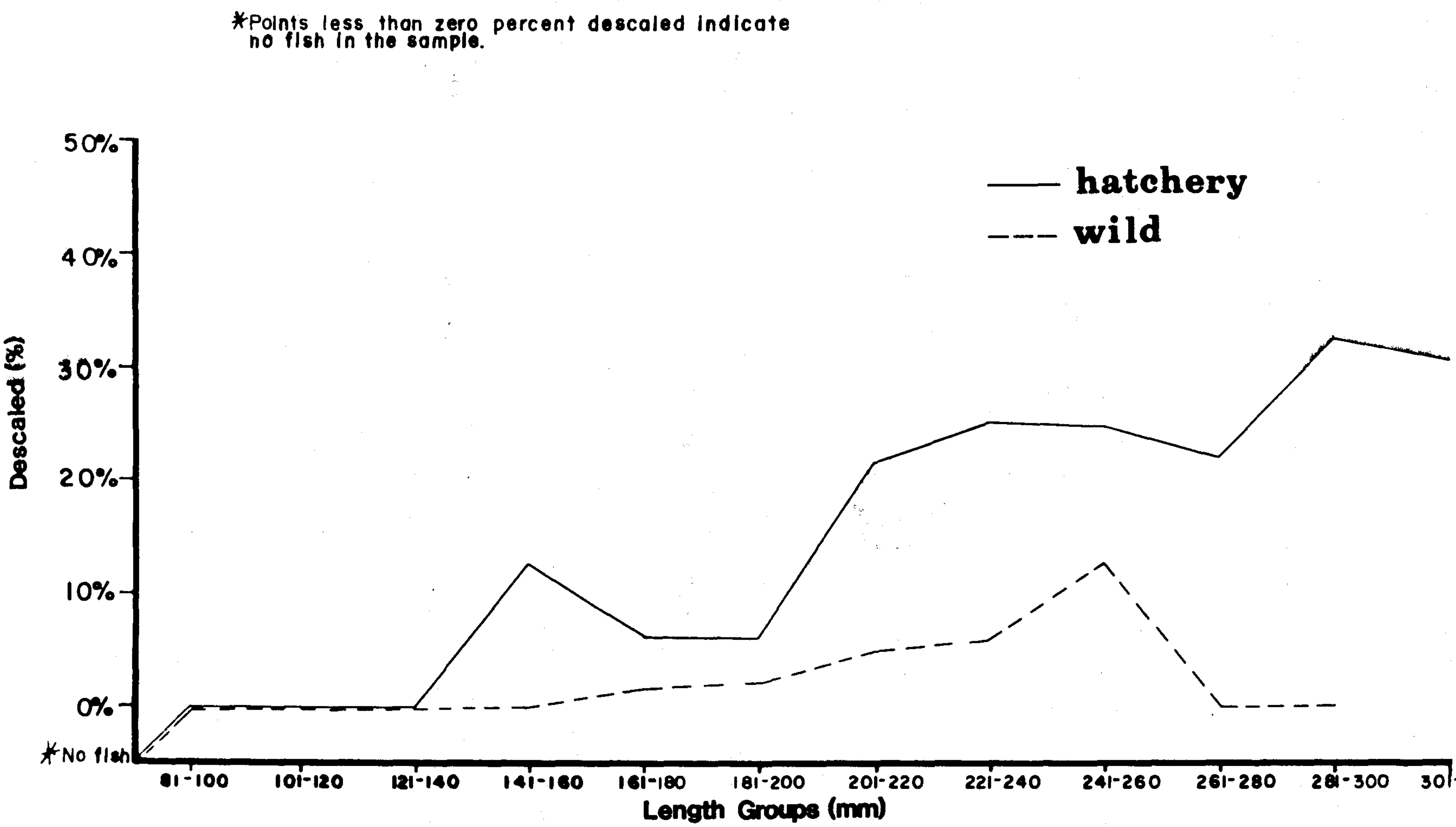


Figure 18. Percent descaling by 20 mm length intervals for wild and hatchery produced steelhead at the Whitebird scoop trap, 1983.

chinook. This large size of smolts is non-typical for wild and most hatchery production. The only smolts of this size that we encountered were reared at Dworshak NFH.

Both wild and hatchery reared steelhead had similar rates of descaling at Red Wolf, remaining relatively low and stable through size groups. Although all Clearwater hatchery production of steelhead occurs at Dworshak NFH, at the main stem and North Fork of the Clearwater River, 39% of the steelhead were pumped to the river or transport trucks rather than being allowed to exit the raceways themselves. If elevated descaling occurred due to this, it was not observed at Red Wolf. Dworshak's steelhead are generally less than 260 mm, the size at which Salmon River hatchery steelhead began showing elevated descaling levels.

Differential Descaling Between Right and Left Sides

We looked at differential descaling between left and right sides of smolts. If one side descaled more than the other, it would indicate that something artificial, such as an activity at the fish hatcheries, or at our traps was causing scale loss on one side more than the other. We found no indication of differential descaling between fish sides (Table 15).

Correlated Areas of Descaling

Abrasive descaling, as opposed to uniform (scattered descaling), frequently occurs to several of the ten areas on a fish's body at once. S.A.S. prepared a correlation matrix which revealed how the percent descaling of each of the ten areas varied with each other on a daily basis throughout the trapping season.

Correlation coefficients ranged from zero to 0.97. We tabulated (Table 16) the correlations where they were at least 0.50, assuming that correlations larger than 0.50 represent strong association between the variables.

The same trend appears as seen with the other evaluations, i.e., symptoms of reduced smolt condition are more evident when fish are passing Whitebird than when passing Red Wolf.

Multiple descaled areas are most common on hatchery steelhead and least common on wild steelhead. Multiple descaled areas on chinook and wild steelhead are more common toward the posterior of the fish, i.e., in areas 1, 2 and 3, than in the anterior areas. Hatchery steelhead seem to have multiple descaled areas in all zones. Multiple areas of descaling are probably the result of scrapes or contusions. Their frequent occurrence on hatchery fish leads to the hypothesis that the descaling is a result of some hatchery or transport procedures.

Cumulative Scale Loss

Classical descaling is rigid in its definition that at least two of the five areas on one side of a fish must be descaled before the fish is

Table 15. Percent of sampled smolts descaled on the left and right sides in 0, 1 and 2 areas.

			Percent descalin9					
				Left side			Right side	
Species	Location	Sample	0	1	2	0	1	2
Chinook	Whitebird	20363	96.2	2.3	1.0	96.7	2.1	0.9
Hatchery steelhead	Whitebird	1739	67.6	15.0	10.9	69.6	14.4	11.0
Chinook	Red Wolf	2216	97.2	1.6	1.0	97.2	1.7	0.7
Hatchery steelhead	Red Wolf	294	93.2	4.4	1.7	91.5	4.8	2.4

Table 16. Correlation coefficients of all combinations of two areas of a smolt where R ? 0.50.

Location	Species	Areas descaled	Corr. coeff. .9-.99	Areas descaled	Corr. coeff. .8-.89	Areas descaled	Corr. coeff.	Areas descaled	Corr. coeff.	Areas descaled	Corr. coeff.
Whitebird	Chinook	L1 R1	.96	L1 R2	.89	L1 L2	.74	R2 R4		R1 L4	.55
				R1 R2	.88	R3 L4	.74	L2 L3		R3 R4	.50
				R2 R3	.85	Ll R3	.73	L2 R2			
						R1 R2	.72				
						RI R3	.72				
Whitebird	Wild steelhead			L4 R4	.80	L2 L3	.79	L1 R1	.69	Li R3	.59
						L2 R2	.73	R2 R3	.69	L4 L5	.57
						R1 R3	.72	R1 R2	.61	L2 R3	.52
										L3 R3	.50
Whitebird	Hatchery steelhead	L2 L3	.93	R2 R3	.86	L1 R1	.73	R2 R4	.68	L1 L3	.58
		L3 R3	.90	L2 L3	.84	L1 L2 ,	.72	L3 L4	.67	Ll R3	.56
				R2 L3	.84	L1 R2	.77	R3 L4	.64	L2 L4	.56
				L2 R3	.81			R1 R2	.64	L4 L5	.56
								L2 R4	.63	R2 L4	.55
								L3 A4	.63		
								R3 R4	.63		
								R1 L2	.62		
								L4 R4	.62		
Red Wolf	Chinook			L1 R1	.85	R3 L4	.79	L1 L2	.68	R1 L2	.58
				R1 R2	.81			L1 R2	.64	Li L2	.51
								R4 R5	.61		
Red Wolf	Wild steelhead			L2 L3	.89						
Red Wolf	Hatchery steelhead	L2 L3	.97	Ll R1	.86	L5 R5	.75	R4 R5	.67		
		R2 R3	.92	R4 R5	.83						

Number of Correlations:

	White bird		Red Wolf
Chinook	14	Chinook	8
Wild steelhead	11	Wild steelhead	1
Hatchery • steel head	23	Hatchery steelhead	6

considered descaled. If two areas, one on each side of the fish are descaled, no record is made of this, nor is the severity of descaling recorded to distinguish the percent of fish that have two, three...ten areas descaled. We calculated the percent of fish for each species and trap location that had one, two, three...ten areas descaled to see if the severity of descaling changed Bch through the season and between trap sites.

At Whitebird, the percent of chinook smolts with at least one area descaled increased as the season progressed from 2% in mid-March to 25% in late May (Fig. 19). The majority of chinook with scale loss had only one area descaled. Usually the amount of fish having three or more areas descaled exceeded the number that had only two areas descaled. Probably about half of the fish with two areas descaled would be classically descaled since both descaled areas would have to be on one side of the fish for this to occur. One point which should be obvious from this discussion is that a large percent of fish have at least one, and sometimes two (one on each side) areas descaled. Unfortunately, this is not usually reported or considered by those who attempt to improve migration conditions to reduce "descaling".

About 1% of wild steelhead at Whitebird had one area descaled (Fig. 20). Two areas descaled was generally less common than three or more areas descaled.

Hatchery steelhead with only one area descaled ranged from 6-16% weekly (Fig. 21). Those with at least one area descaled, some of which had up to eight and nine areas descaled, ranged between 20-45%.

At Red Wolf, scale loss was generally less than at Whitebird. Chinook with single areas descaled were generally less than 3% of the sample (Fig. 22). Smolts with three, four and five areas descaled were as common as smolts with only two areas descaled.

Sample size of wild steelhead at Red Wolf was so small that no meaningful inferences can be drawn from the data (Fig. 23).

During most weeks, hatchery steelhead with scale loss at Red Wolf had at least two areas descaled. Disregarding the data from June when sample size was insufficient, hatchery steelhead with at least one area descaled ranged from 6-16% of the weekly samples (as compared to 20-45% at Whitebird).

In summary, the severity of descaling varies greatly from only a single area to five or more areas, a situation which may result in a high incidence of mortality. If the relative mortality rate associated with each degree of descaling, i.e., one, two, three...ten areas, was known, then a weighted estimate of expected mortality could be calculated. For example, if 1,000 fish were sampled and

50 had 1 area descaled,
40 had 2 areas descaled,
30 had 3 areas descaled,
25 had 4 areas descaled,

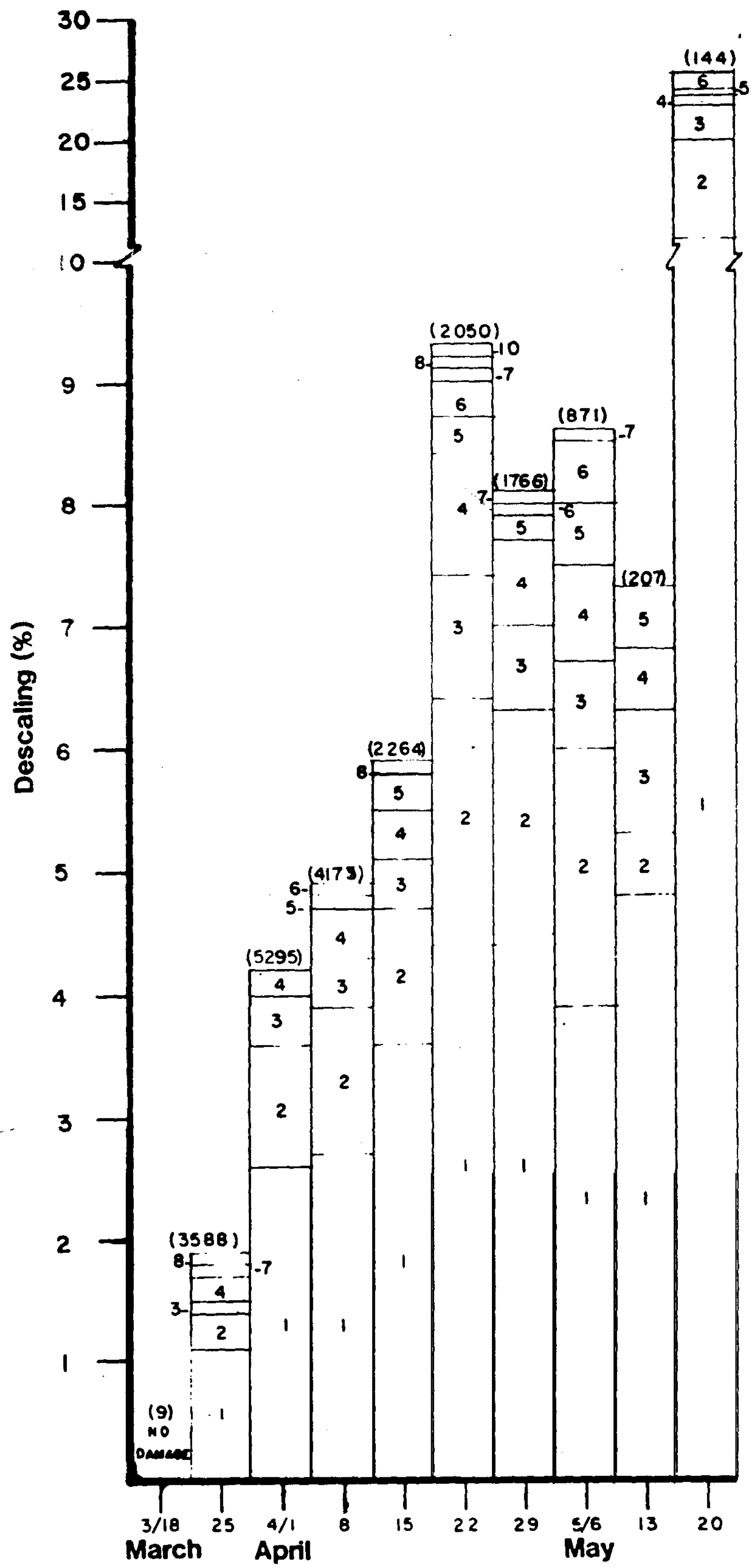


Figure 19. Weekly cumulative percentages of juvenile chinook having one or more areas descaled at the Whitebird scoop trap.

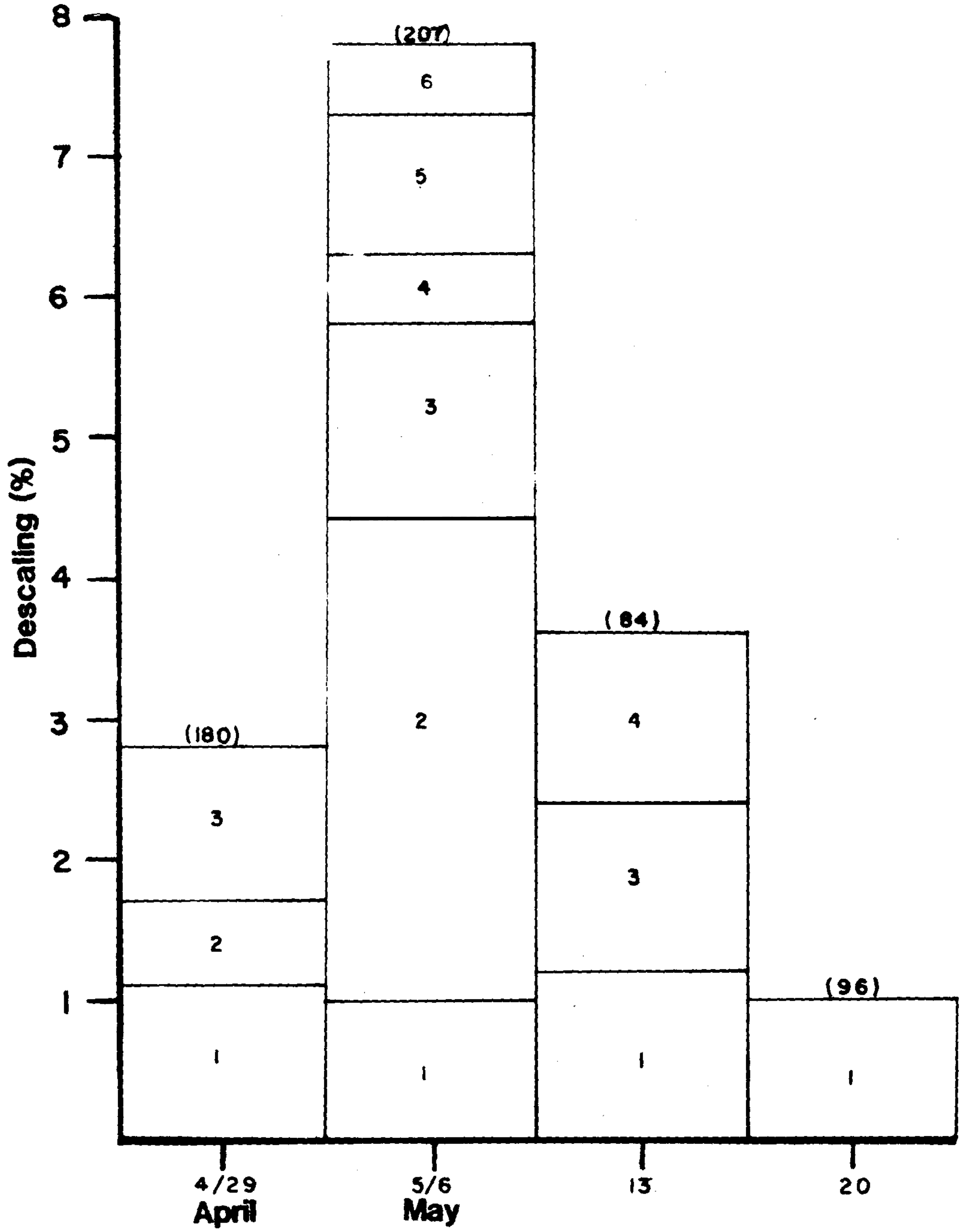


Figure 20. Weekly cumulative percentages of wild steelhead smolts having one or more areas descaled at the Whitebird scoop trap.

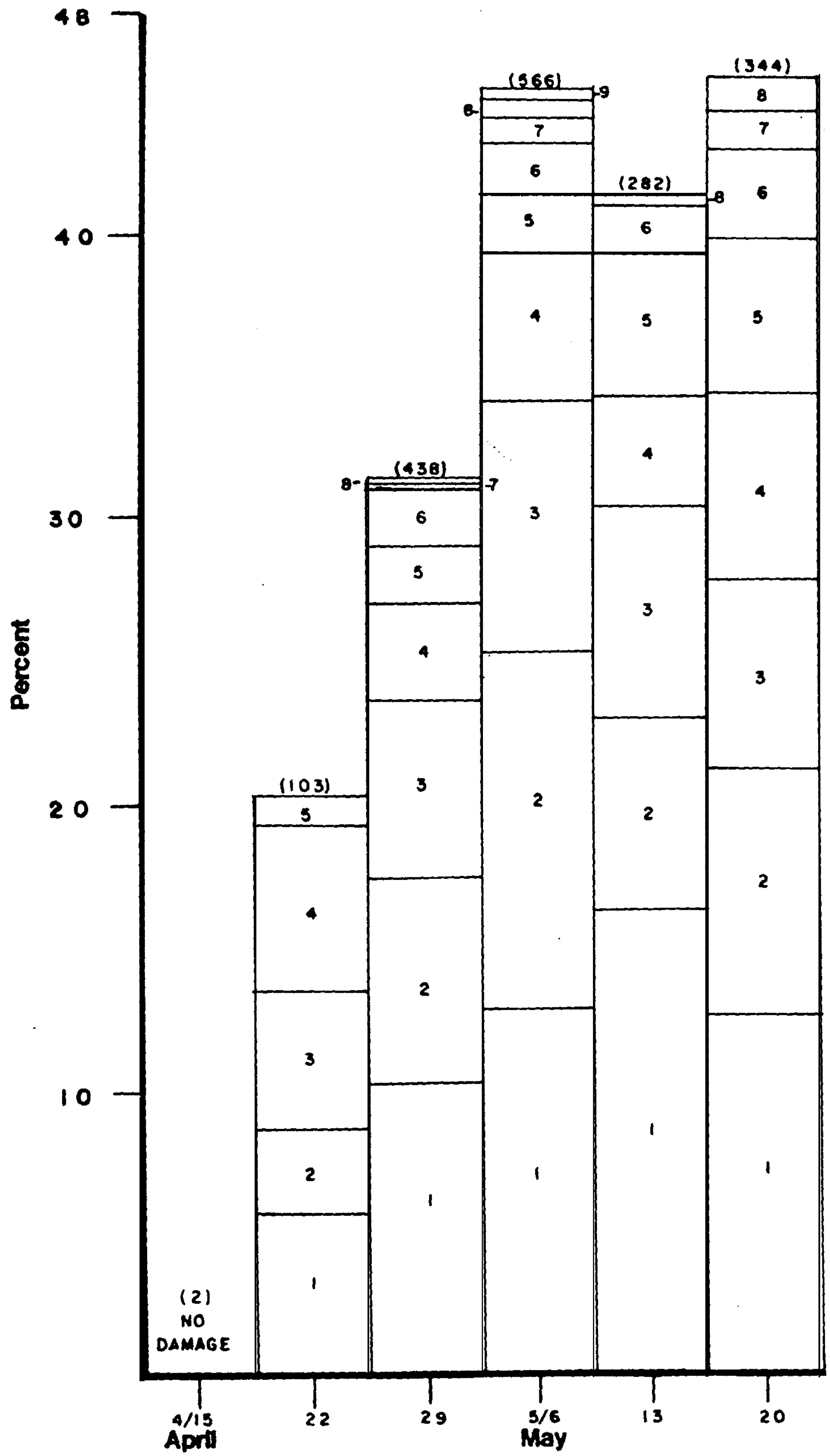


Figure 21. Weekly cumulative percentages of hatchery steelhead smolts having one or more areas descaled at the Whitebird scoop trap.

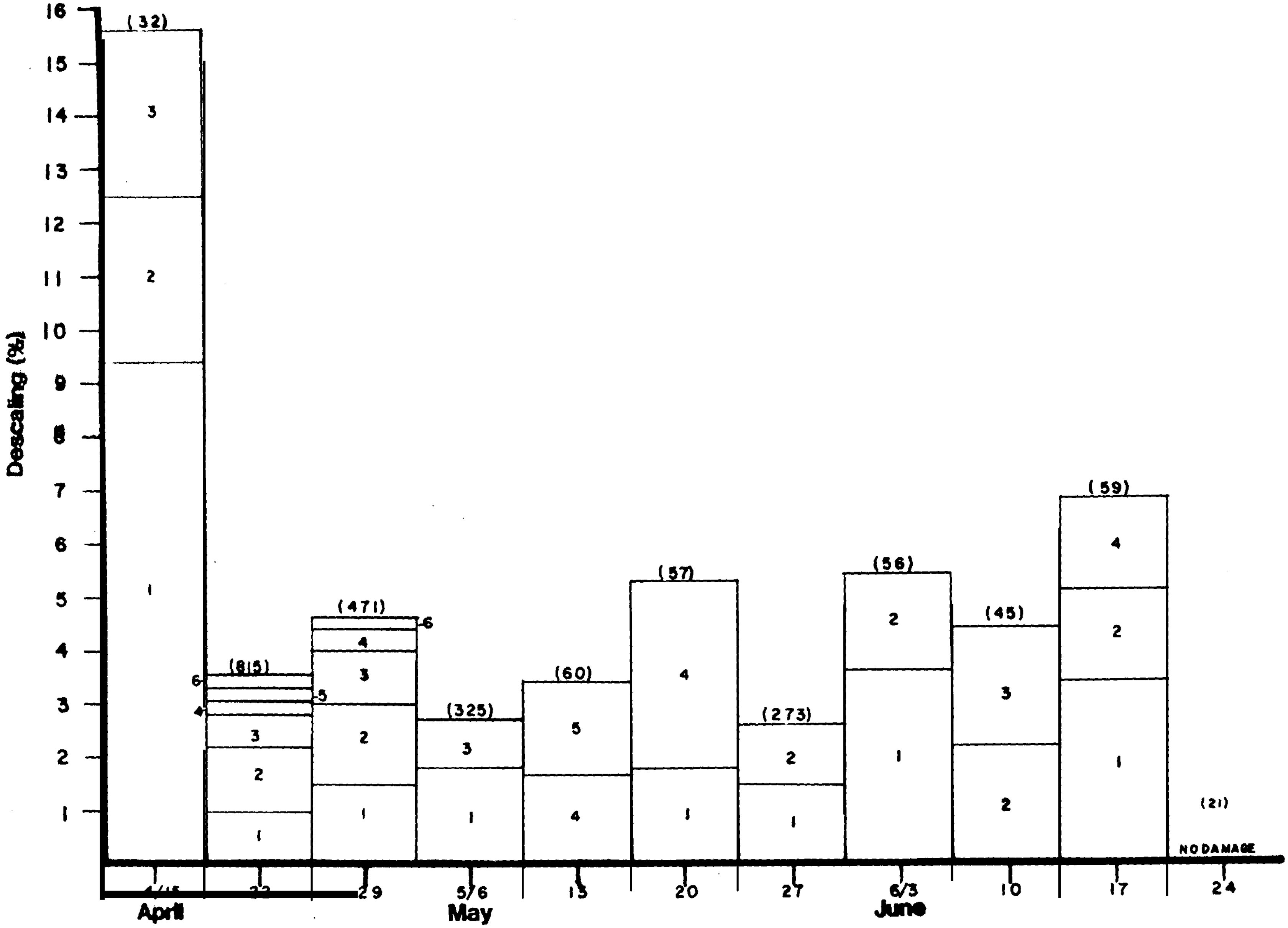


Figure 22. Weekly cumulative percentages of juvenile yearling chinook having one or more areas descaled at the Red Wolf dipper trap, 1983.

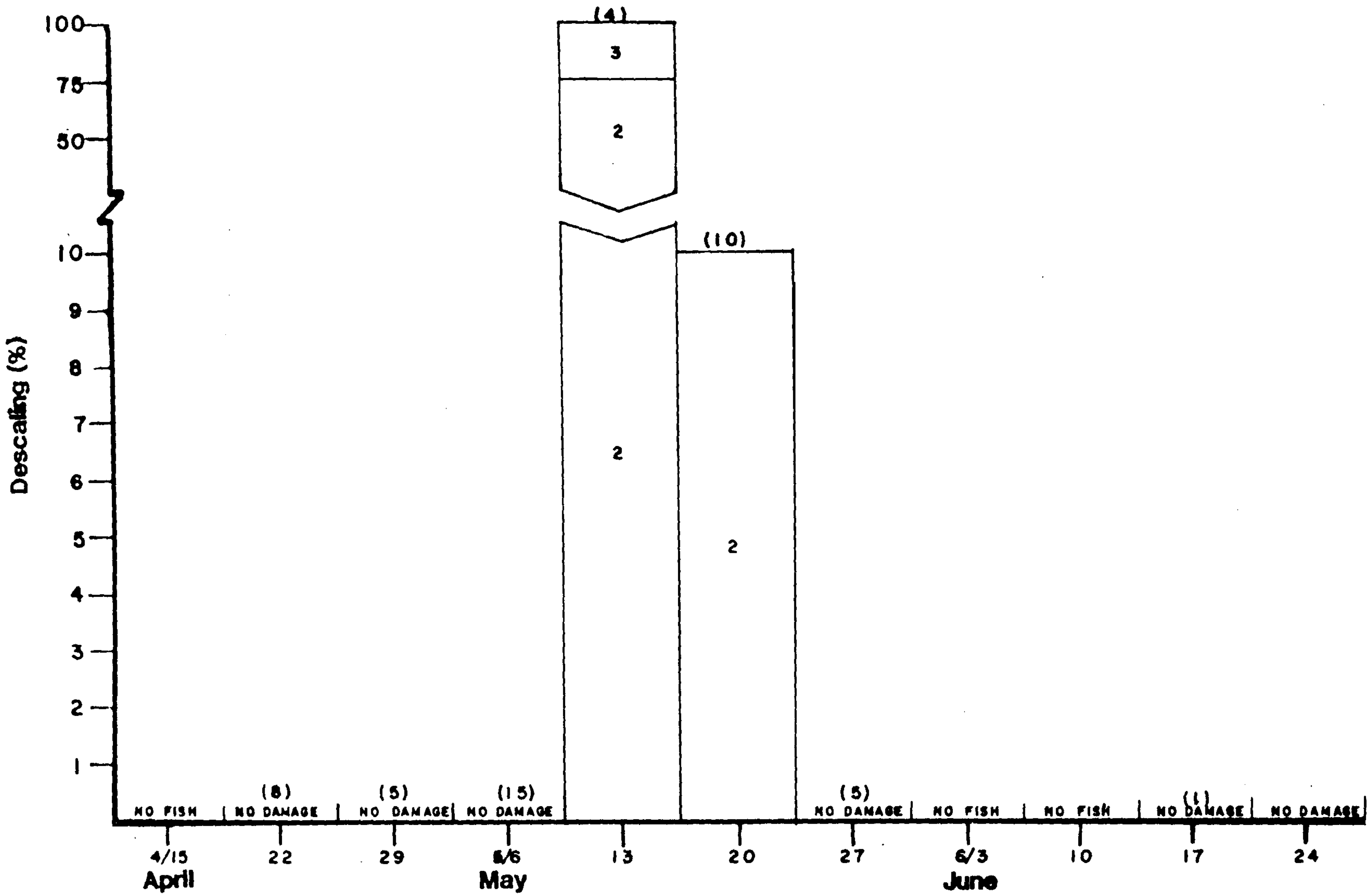


Figure 23. Weekly cumulative percentage of wild steelhead smolts having one or more areas descaled at the Red Wolf dipper trap, 1983.

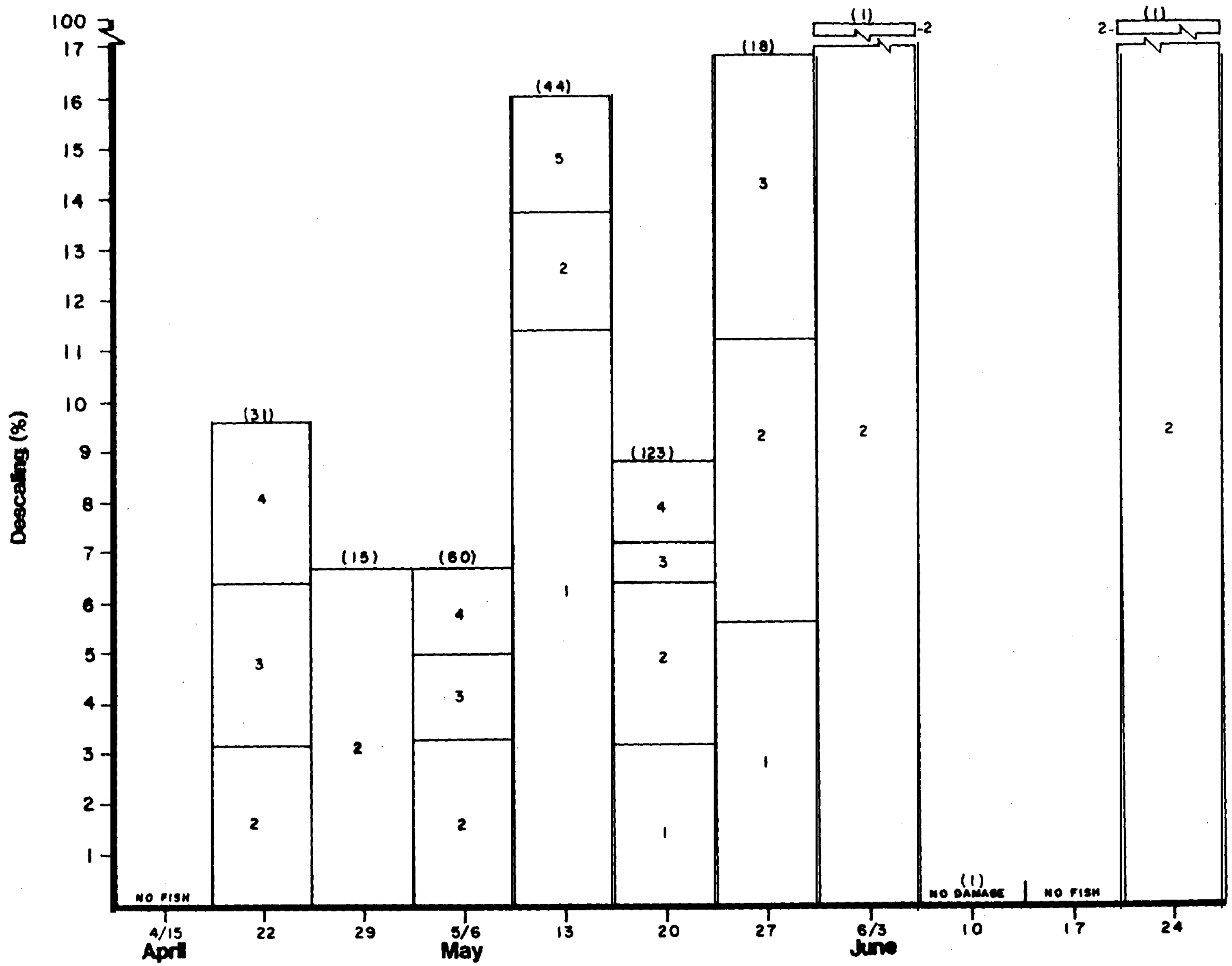


Figure 24. Weekly cumulative percentages of hatchery steelhead smolts having one or more areas descaled at the Red Wolf dipper trap, 1983.

10 had 5 areas descaled,
2 had 6 areas descaled, I
had 7 areas descaled,

and the expected mortality from one through seven areas descaled was 10, 15, 20, 25, 30, 35 and 40%, then the expected percent mortality of the population based on the sample would be:

50 x .1	=	5
40 x .15	=	6
30x .2	=	6
25 x .25	=	6.25
10 x .3	=	3
2 x .35	=	0.7
1 x .40	=	0.4

Total 27.4/1000 = 2.7% mortality

A system such as this would specify the effects of descaling. Laboratory tests such as a salt water challenge could be used to determine the mortality rates associated with a given number of descaled areas. This system would help determine what happens to smolts migrating between points such as in the 106 mile interval between Whitebird and Red Wolf. The level of descaling decreased considerably for smolts between these points. The reason, I believe, is that descaled smolts suffer a differentially high mortality. Thus, the farther down the system they are sampled, the smaller is the percent of descaled smolts. Most of the smolts which were heavily descaled when in the upper system are probably among those that did not survive to Lower Granite Dam.

Length Frequency Distributions

At Whitebird we examined up to 900 smolts daily when available from March 22 until April 3, after which time we examined up to 600 smolts daily. These fish were measured and daily length frequency histograms (Figs. 25 to 30) were constructed to assist with identifying the passage of different hatchery releases and determining the relative contribution of hatchery and wild smolts.

Daily mean total length of chinook smolts ranged from 115 to 136 mm with most means lying between 123 and 132 mm. There was a general trend for mean length to decrease through the season from values near 130 mm in March to near 125 in May (Fig. 31). Length distributions were narrowest in March, i.e., standard deviations were 8-9 mm and increased to 10-12 mm from then until April 22, then increased further, ranging up to 18 mm for large samples. Increased standard deviation probably indicates a mixture of populations. Mean total length of chinook smolts released from Rapid River, Pahsimeroi, South Fork Salmon River and Decker Flats were 129, 127, 124 and 124 mm, respectively. Mean passage time of smolts at Whitebird of these four groups were 4/7, 4/9, 4/22 and 4/28. Thus, the seasonal decrease in mean length of chinook at Whitebird is most probably a result of sequential passage of these hatchery releases.

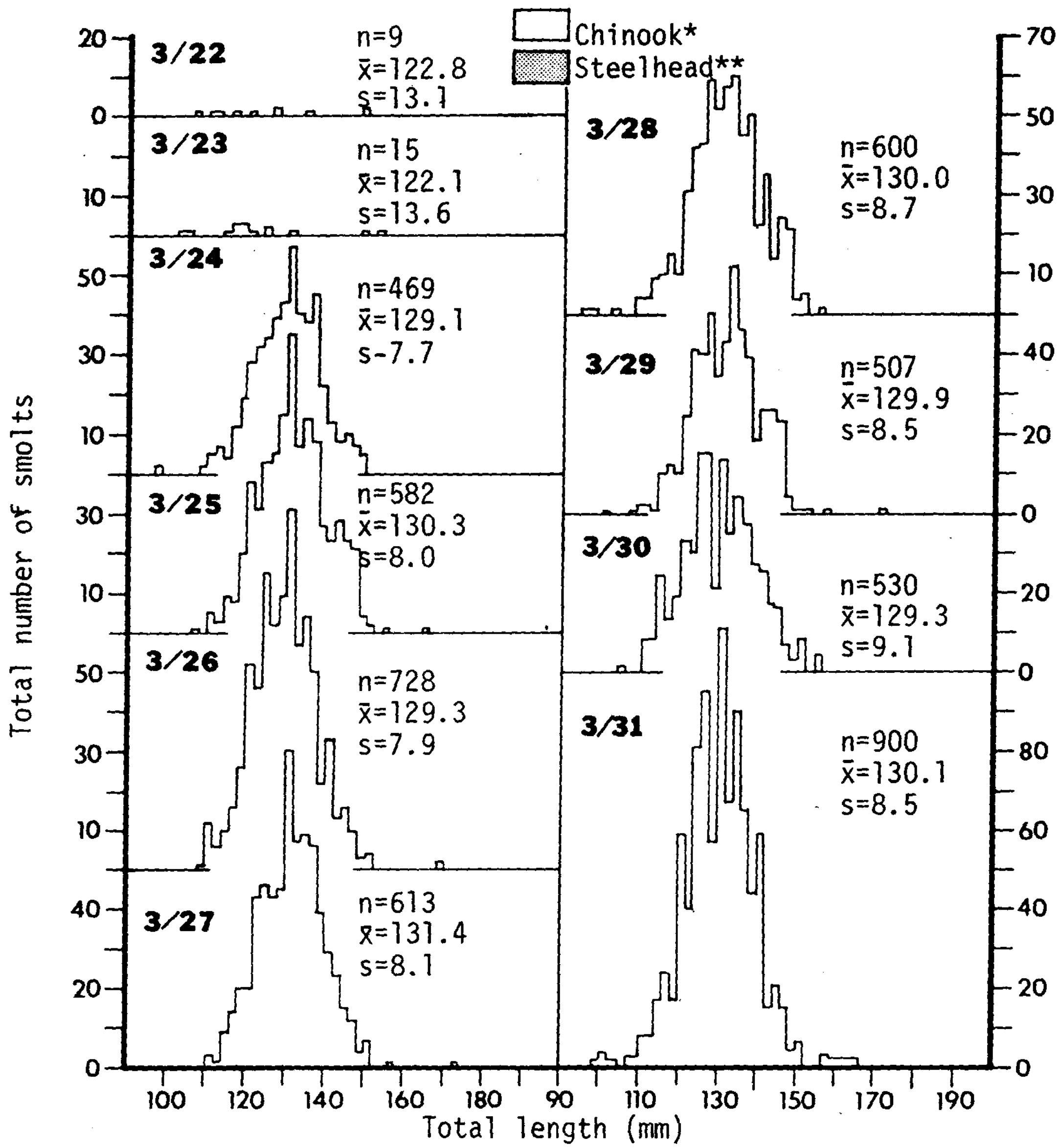


Figure 25. Daily length frequency distributions of smolts entering the Salmon River migrant scoop trap at Whitebird, ID (March 22-March 31, 1983). Sample size (n), mean length ($\bar{x}$), standard deviations (s) are given.

*One chinook was measured at 76 mm on 3/29/83.
** No steelhead were captured during this time interval.

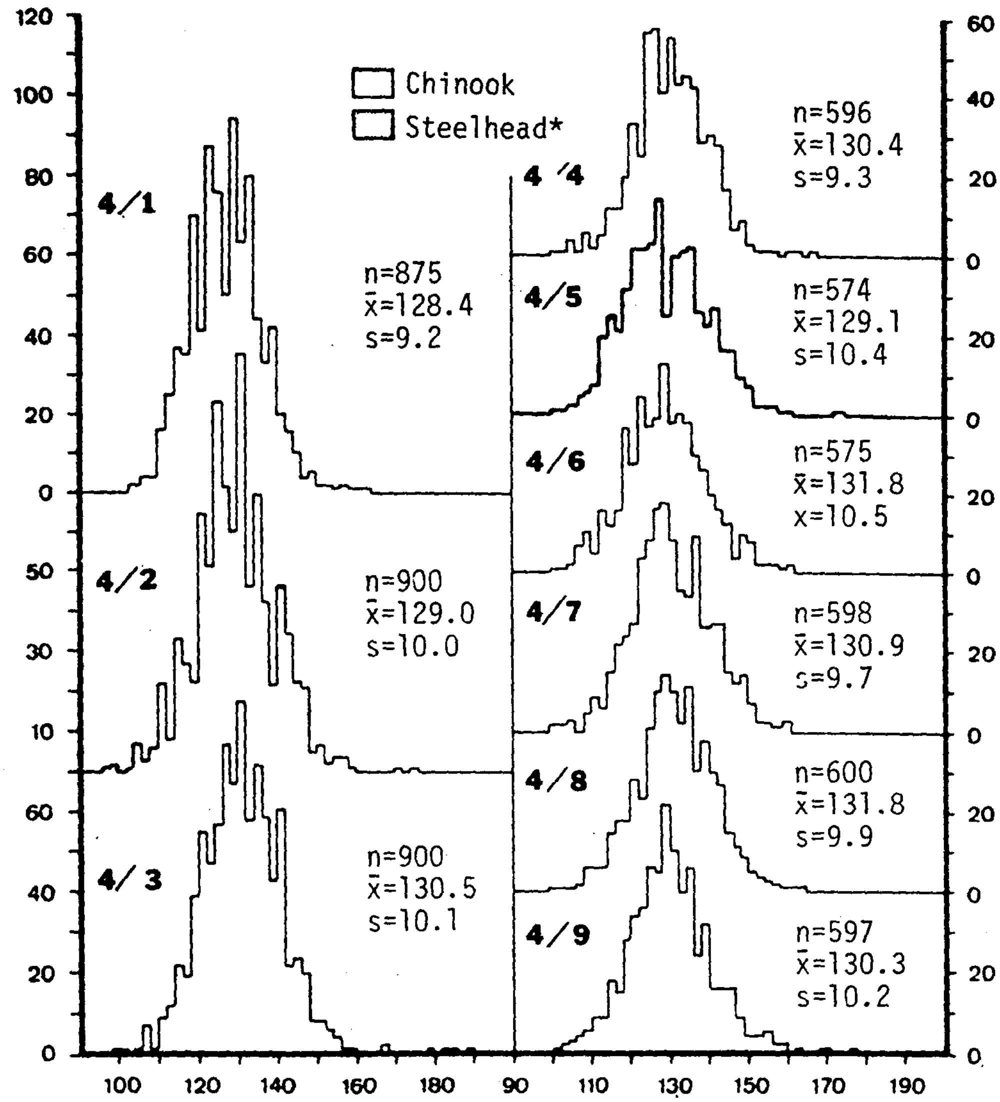


Figure 26. Daily length frequency distributions of smolts entering the Salmon River migrant scoop trap at Whitebird, ID (April 1-April 9, 1983). Sample size (n), mean length ($\bar{x}$), standard deviations (s) are given.

*No steelhead were captured during this time interval

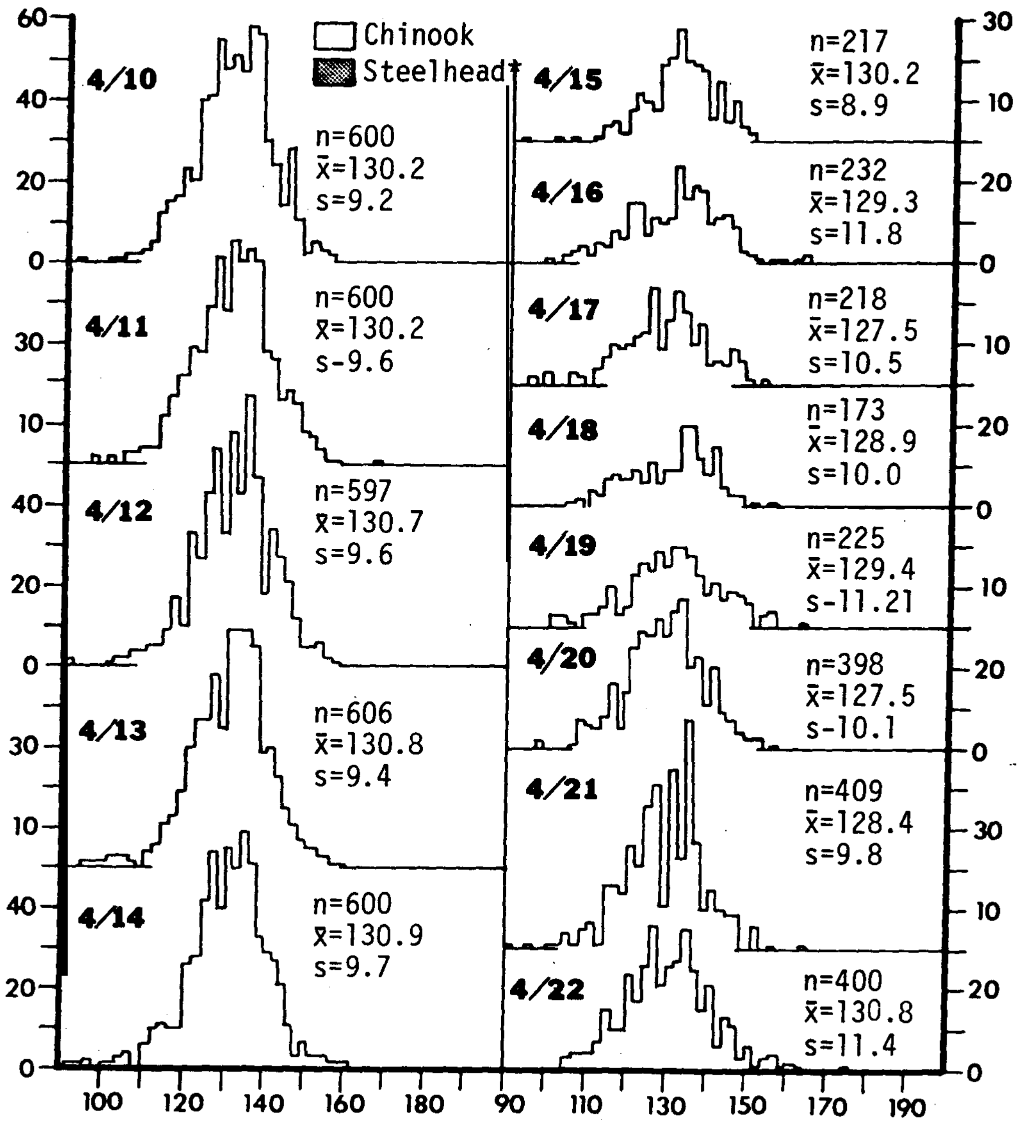


Figure 27. Daily length frequency distributions of smolts entering the Salmon River migrant scoop trap at Whitebird, ID (April 10-April 22, 1983). Sample size (n), mean length ($\bar{x}$), standard deviations (s) are given.

*Only 5 steelhead were trapped during the time interval 4/10/83 - 4/22/83. They were of lengths 125 mm, 182 mm, 199 mm, 235 mm, on 4/20/83 and 182 mm on 4/22/83.

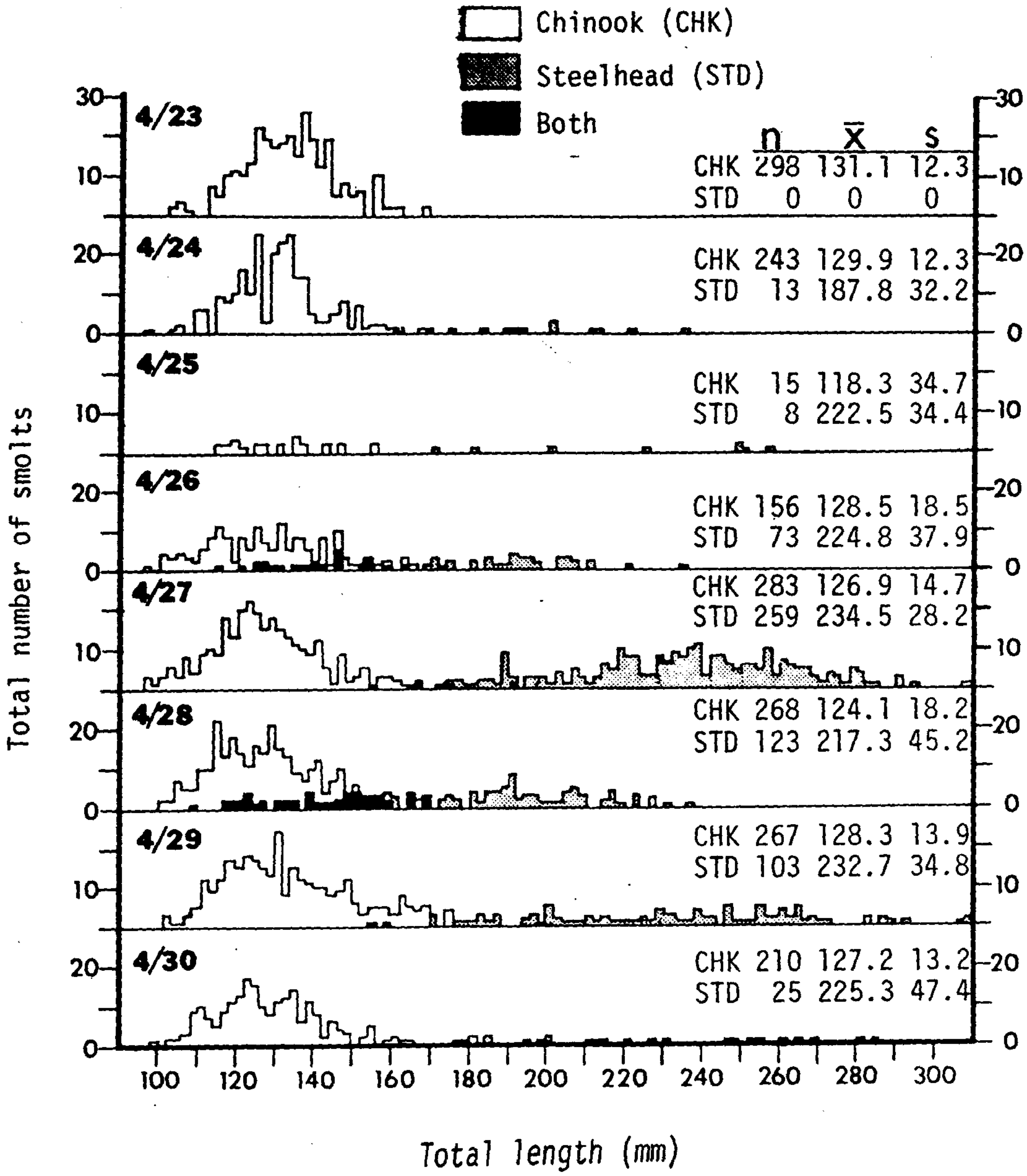


Figure 28. Daily length frequency distributions of smolts entering the Salmon River migrant scoop trap at Whitebird, ID (April 23-April 30, 1983). Sample size (n), mean length ($\bar{x}$), standard deviations (s) are given.

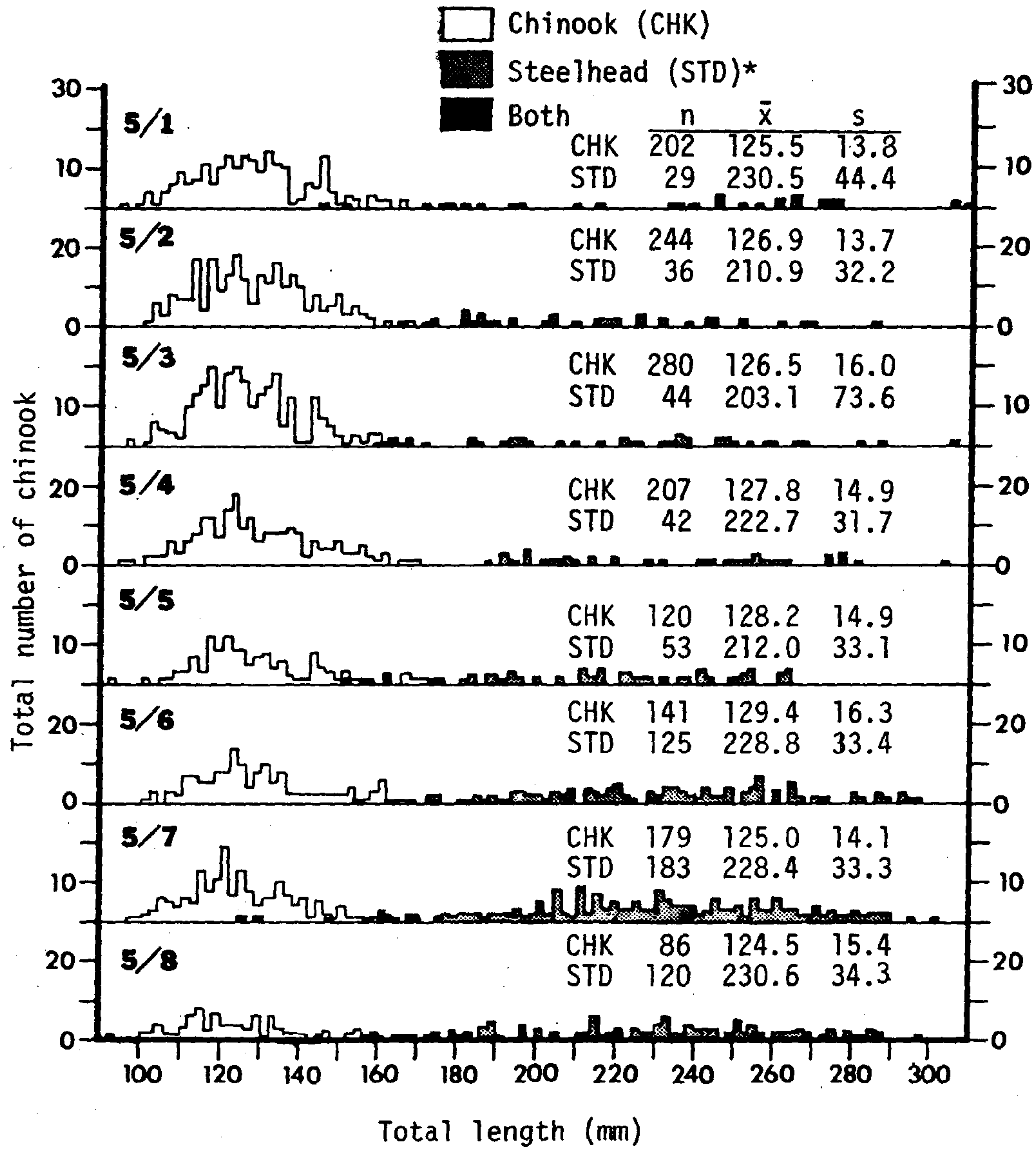


Figure 29. Daily length frequency distributions of smolts entering the Salmon River migrant scoop trap at Whitebird, ID (May 1 - May 8, 1983), Sample size (n), mean length ($\bar{x}$), standard deviations (s) are given.

*One steelhead was measured at 330 mm on May 8, 1983.

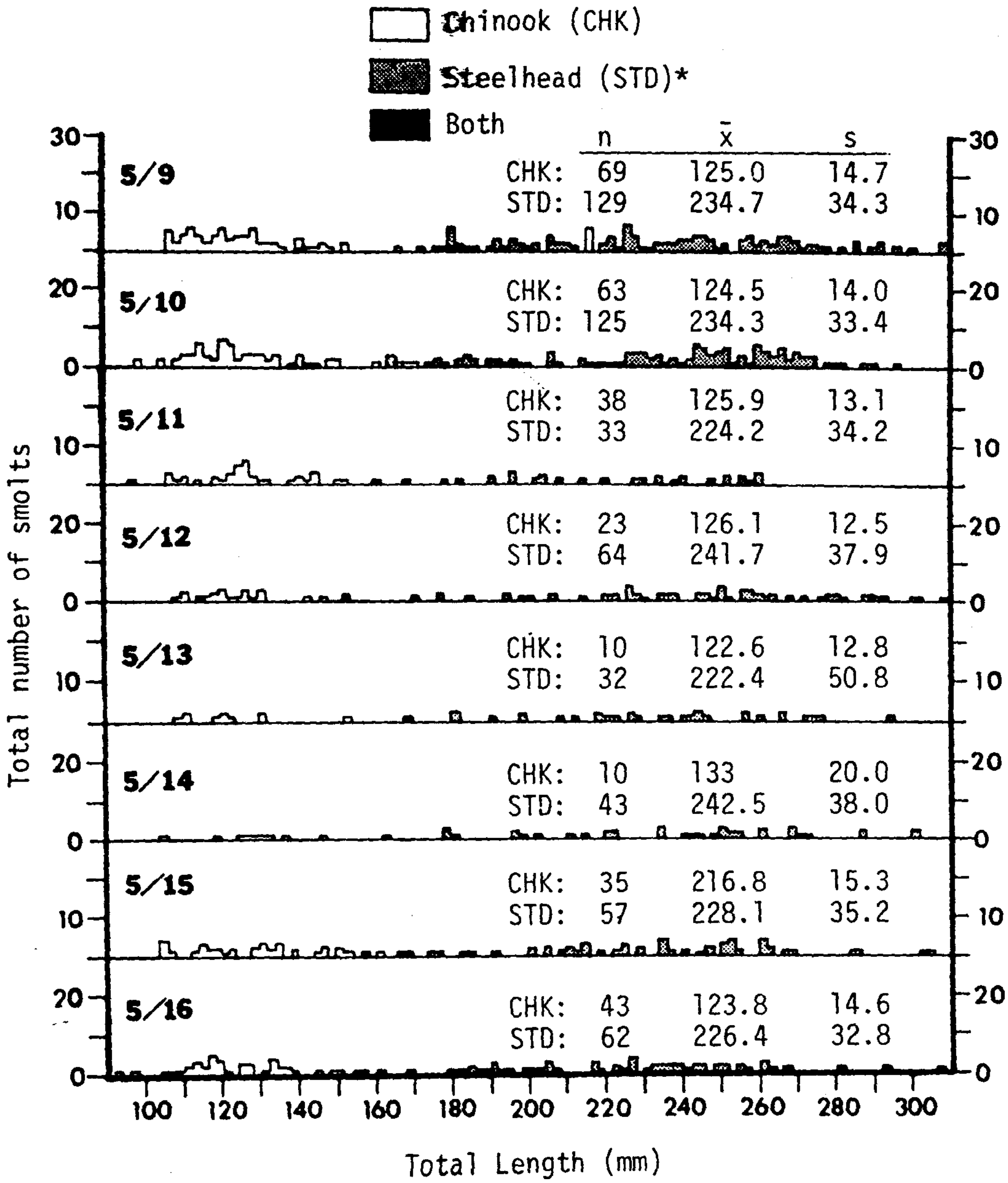


Figure 30. Daily length frequency distribution of smolts entering the Salmon River migrant scoop trap at Whitebird, ID (May 9-May 16, 1983). Sample size (n), mean length ($\bar{x}$), standard deviations (s), are given.

*Four steelhead measured larger than 310 mm. They were measured at 321 mm on May 11; 325 and 327 mm on May 14; 315 mm on May 16.

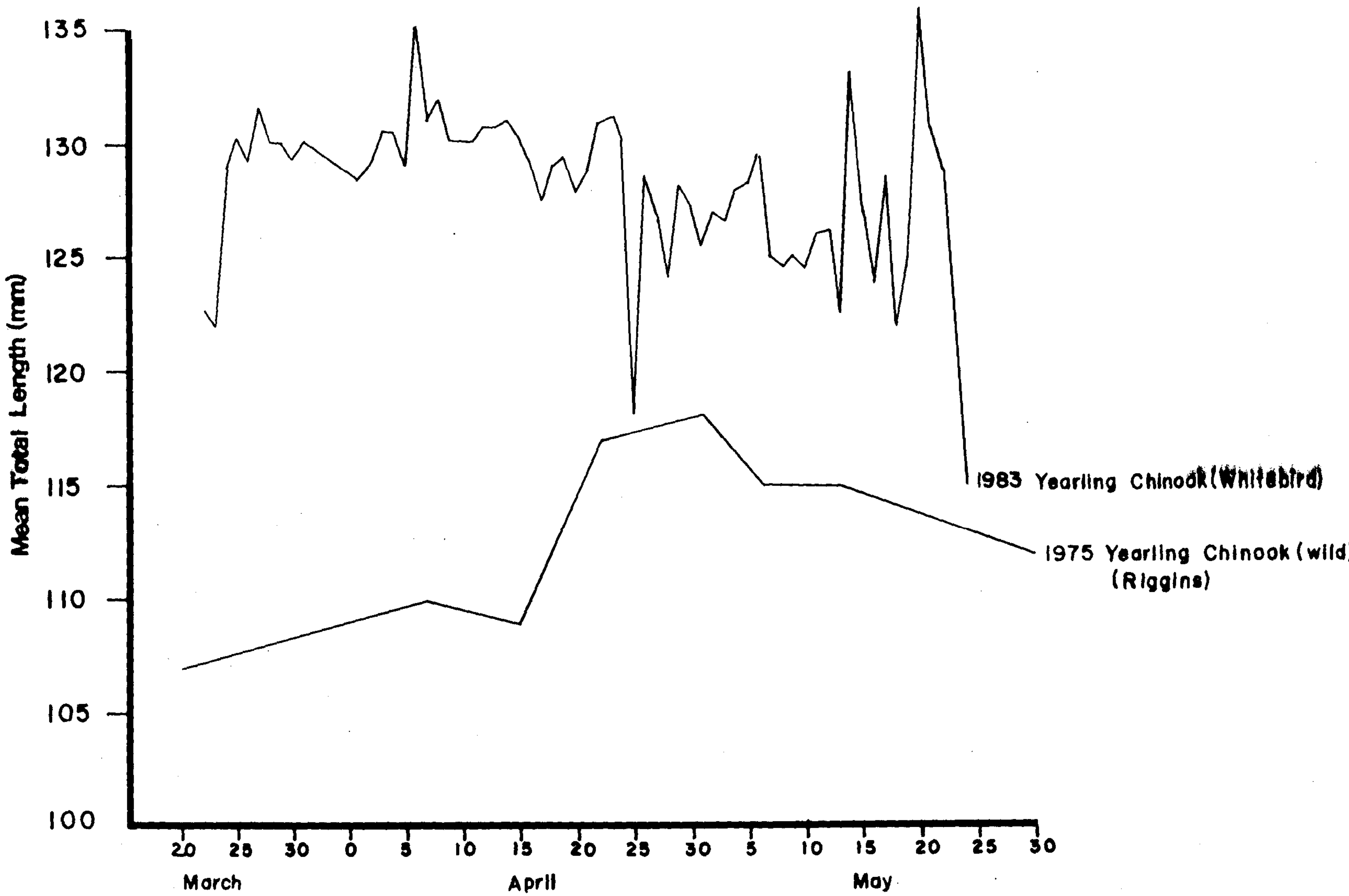


Figure 31. Daily mean lengths of chinook smolts at Whitebird in 1983 (upper line) and occasional mean lengths of chinook smolts from the Salmon River upstream from Rapid River in 1975.

In 1975, NMFS collected length frequency data at Riggins, upstream from the mouth of Rapid River. These data are presented along with the daily mean lengths at Whitebird in 1983 '(Fig. 30). The two resulting lines indicate that smolts coming down the Salmon River were much smaller in 1975 than at present. The percent of wild fish i n these samples was probably very high in 1973 even with several hundred thousand chinook smolts having been released from Pahsimeroi and Decker Flats that year. Mains and Smith (1955) found that modal total lengths of yearling chinook smolts in the lower Snake River ranged from 103-115 mm, similar to the 1975 data of Figure 30.

Besides the size distributions which have modal lengths from 125 to 130 mm, there appears to be a contribution of smaller smolts with a modal length near 105 mm. These may be wild fish or "runts" from bimodal hatchery populations. Whatever their source, it is a very small component, probably less than 5% of the outmigration.

Steelhead were not caught in the Whitebird trap until April 20, and it was not until April 26 that they arrived in significant numbers. Mean lengths were large, being generally between 220 and 230 mm. Standard deviations were large, generally 30 to 40 mm, such that the distributions appeared flat with no obvious modes.

Hatchery steelhead released into the Salmon River came from three sources, Hagerman NFH, Magic Valley Hatchery and Niagara Springs Hatchery. Mean lengths from samples just prior to release at Magic Valley ranged from 221 to 233 mm; from Niagara, 218 to 241 mm; and from Hagerman, 206 to 281 mm. Thus, Magic Valley and Niagara smolts had modal lengths near that of the Whitebird steelhead samples whereas the Hagerman smolts covered the entire range of Whitebird smolt lengths. Since few branded steelhead were observed at Whitebird, we were unable to determine when each hatchery release group passed Whitebird.

Unpublished data on length frequency distribution of wild steelhead seen at Lower Granite Dam in 1977 was provided by the Cooperative Fishery Unit, University of Idaho (R.R. Ringe, pers. comm.). Mean lengths from five large samples taken between early May and early June were 203, 207, 201, 200 and 209 mm. These lengths are considerably smaller than hatchery reared steelhead released into the Salmon River in 1983. Our daily length frequency distributions indicate that throughout the migration a significant part of the trapped steelhead was composed of wild fish. Because most hatchery steelhead can be identified as such by their eroded fins, we were able to enumerate hatchery and wild steelhead separately. Figure 4 represents the daily numbers of each group captured at Whitebird. Wild steelhead made up 20% of the steelhead catch.

Mains and Smith (ibid.) show length frequency distribution of wild steelhead smolts with mean lengths of approximately 160 mm in the lower Snake River. From our trap samples, mean lengths of wild steelhead at Whitebird and Red Wolf are approximately 190 and 175 mm, respectively. Mean lengths of hatchery smolts from the same sites are 240 and 220 mm. The smaller sizes at Red Wolf are probably due to the mixing of Snake River with Clearwater River smolts, assuming that the latter are generally smaller. For hatchery steelhead at least, this is correct as sample mean lengths of Dworshak reared steelhead smolts ranged from 185-201 mm, considerably smaller than those released into the Salmon River.

Experimental Electro-fishing

We borrowed an electro-fisher (EF) to test its applicability to:

1. Estimate descaling in the forebay and tailrace of Lower Granite Dam.

2. Verify the trend in descaling, relative species composition and relative abundance obtained in the traps.

3. Supply additional samples for use in recovering hatchery brands.

4. Evaluate electro-fishing as a smolt monitoring method.

The EF was available to our project April 27-May 2, and again May 31-June 5. The peak of the spring chinook outmigration had just passed the study area and steelhead had just begun arriving during the former sampling week. During the latter week, most spring chinook and steelhead had already passed downstream (Figs. 32 and 33). Thus, neither sample week coincided with large densities of smolts.

Catch rates varied considerably between months and between locations (Table 17). One of the lowest catch rates occurred near Lower Granite Dam in both the forebay and tailrace. Electro-fishing is only effective in shallow water (5- 6 feet deep) which occurs near shorelines. Additionally, most of the shoreline in the Lower Granite forebay are precipitous, again reducing electro-fishing efficiency. In the tailrace area, smolts have recently passed through the powerhouse or over the spillway and possibly for these reasons, few were encountered along shorelines. Due to the electro-fisher's lack of effectiveness over deep water, we were unable to capture separate samples of smolts from the spillway and powerhouse for descaling comparisons. Thus, objective 1 above, could not be achieved, although fairly large samples were at times available in areas such as the Clearwater and Salmon rivers.

We compared catch statistics between traps and the EF, twice at Red Wolf and once at Whitebird (Table 18). Electro-fishing statistics agreed closely with those of the traps. Catch statistics for the dipper and Snake River south shore electro-fishing were very similar, both differing considerably from north bank catches. The trap is closer to the south bank and the north bank is mainly in the Clearwater River plume, thus, a difference would be expected. The decrease in catch per unit effort between months at Red Wolf, the relative species compositions and percent descaling where sample size was reasonably large were consistent between sampling methods. Since the trends in these three statistics are the same for the two sampling methods, this enhances the assumption that each method is correctly representing the parameters studied.

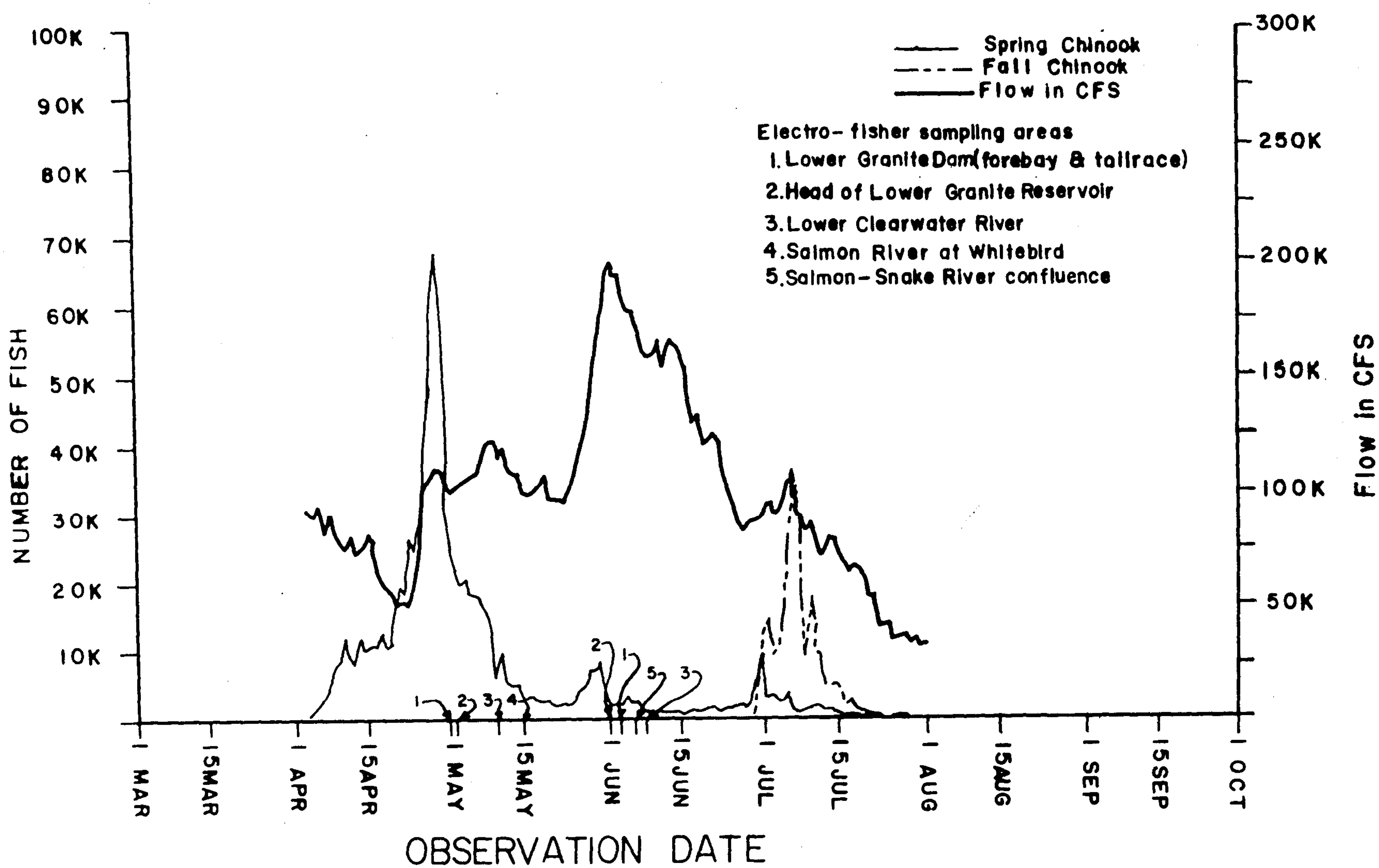


Figure 32. Daily passage of juvenile chinook migrants at Lower Granite Dam relative to seasonal discharge. Figure taken from FTOT 1983 annual report. Numbers (1-5) indicate sampling locations and dates. Sampling dates have been adjusted relative to the chinook passage at Lower Granite Dam to correspond with estimated passage at each electro-fisher sampling site.

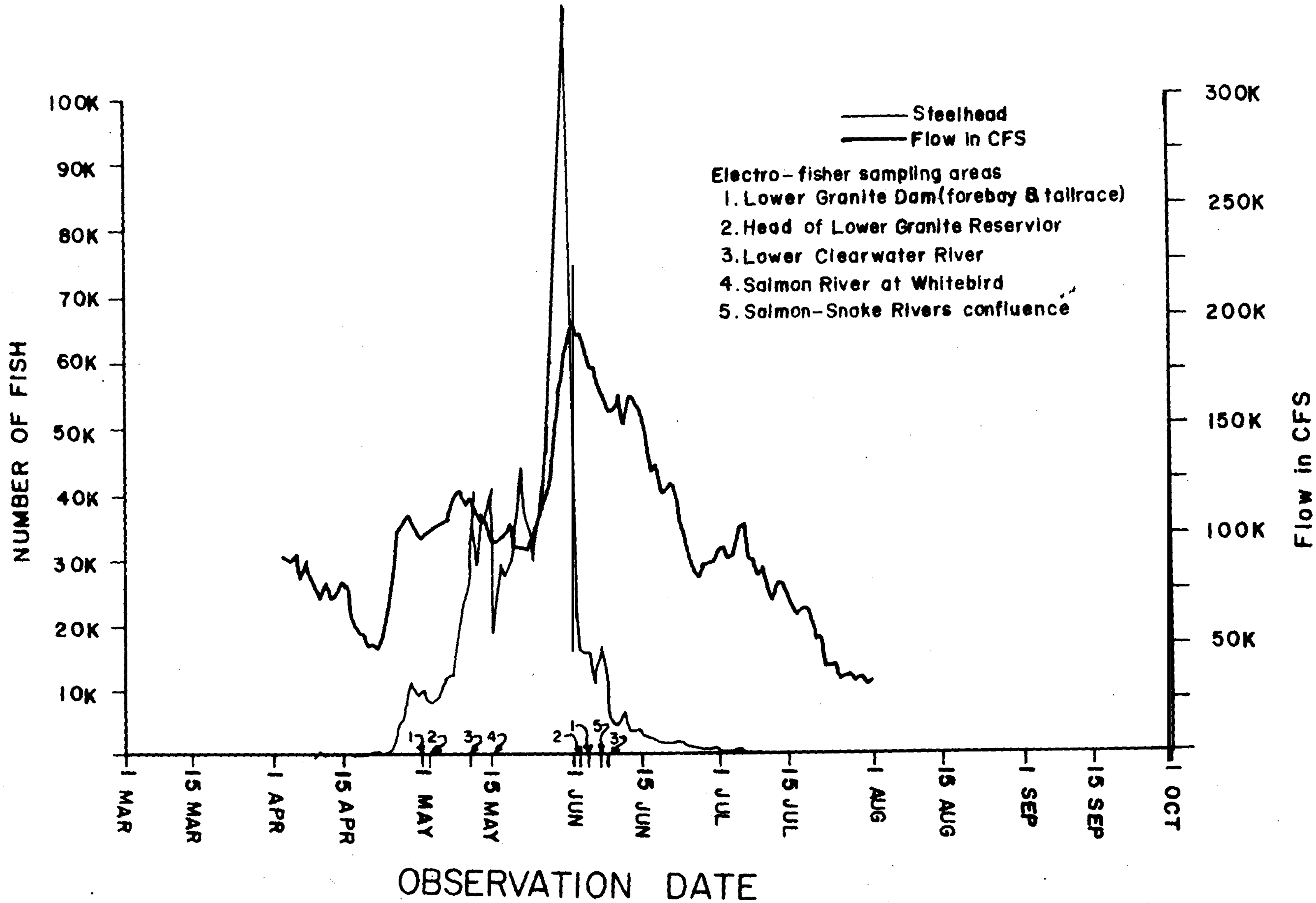


Figure 33. Daily passage of juvenile steelhead migrants at Lower Granite Dam relative to seasonal discharge. Figures taken from FTOT 1983 annual report. Numbers (1-5) indicate sampling locations and dates. Sampling dates have been adjusted relative to the steelhead passage at Lower Granite Dam to correspond with estimated passage at each electro-fisher sampling site.

Table 17. Catch rate, species composition and percent descaling for electrofishing samples in the Snake, Salmon and Clearwater rivers, 1983.

	Sample 1 April 27 - May 2	Sample 2 May 31 - June 5
Red Wolf (N. side)	4/27-28	5/31
Smolts/hr	5	4
% Chinook/steeihead	40/60	0/100
• % Descaled	20	0
Sample size	5	1
Red Wolf (S. side)	4/27-28	5/31
Smolts/hr	22	0
% Chinook/steelhead	96/4	N.A.
Descaled	9	N.A.
Sample size	22	0
Snake River (E. Clarkston)	4/28	5/31
Smolts/hr	10	0
% Chinook/steelhead	40/60	N.A.
% Descaled	0	N.A.
Sample size	5	0
Salmon River (Whitebird)	4/29-30	(RM 0-1} 6/1
Smolts/hr	46	0
% Chinook/steelhead	83/17	N.A.
% Descaled	1	N.A.
Sample size	119	0
Lower. Granite Forebay	5/1	6/5
Smolts/hr	5	0
% Chinook/steelhead	100/0	N.A.
% Descaled	0	N.A.
Sample size	8	0
Clearwater River (RM 0-1)	4/27-28	5/31
Smolts/hr	107	0
% Chinook/steelhead	61/39	N.A.
% Descaled .	2	N.A.
Sample size	107	0

Table 17. Continued.

	Sample 1 April 27 - May 2	Sample 2 May 31 - June 5
Clearwater River (RM 15-22)	5/2	6/4
Smolts/hr	22	57
% Chinook/steelhead	80/20	74/26
% Descaled	0	1
Sample size	25	84
Lower Granite Tailrace	no sample	6/2
Smolts/hr		4.5
% Chinook/steelhead		22/78
% Descaled		0
Sample size		9

Table 18. Trap and electrofishing comparisons at the head of Lower Granite pool (Red Wolf site) on April 27-28 and May 31 and the Whitebird site onlApril 29-30.

April 27-28, Red Wolf

Catch rates	Dipper	Electrofishing South side	Electrofishing North side
Smolts/hr	5	22	5
% Chinook	98	96	40
% Steel head	2	4	60
% Descaled	2.5	9	70

April 29 and 30, Whitebird

Catch statistics	Scoop trap	Electrofishing
Smolts/hr	13	46
% Chinook	79	83
% Steelhead	21	17
% Descaled	A	0.8

May 31, Red Wolf

Catch statistics	Dipper*	Electrofishing South side	Electrofishing North side
Smolts/hr	0.54	0	4
% Chinook	93	NA	0
% Steelhead	7	NA	100
% Descaled	0	NA	0

*An average of 5/30 and 6/1, the dipper trap was not functioning on 5/31.

The timing of arrival of smolts at the head of Lower Granite Reservoir is determined by the relative abundance of smolts passing that site daily. Arrival time of specific hatchery released smolts is determined by recovering branded fish. Both parameters require that a large sample of smolts be caught and examined daily. On an hourly basis, the electro-fisher generally caught more smolts than did the traps. However, due to the impossibility of maintaining a crew of fishermen on an electro-fishing boat for many hours every day, the actual daily EF sample size would likely be much less than the trap catches. Where additional samples are needed along with trap catches, another method should be chosen.

Smolt monitoring requires that an estimate be made of the relative abundance of smolts passing on a daily basis. The generally accepted method to do this is to release marked fish upstream from the sampling device such that the fish will randomly mix with other fish before again encountering the sampling gear. Some of the fish will be recaptured, thus allowing an estimate of gear efficiency, which when divided into daily catch provides an estimate of relative abundance. However, the gear must fish continually since the marked fish would not necessarily be randomly distributed through time as they pass the gear. Electro-fishing, which requires the constant attention of three people and is not fishing constantly, could not be considered adequate smolt monitoring gear. Based on the above considerations, we decided not to include an electro-fishing boat in the project design.

We fished a beach seine four times in the lower Clearwater River and caught no smolts. The river bottom was rocky and the current too strong for the seine to work properly. Beach seining did not appear to be a viable technique for sampling smolts in a fast flowing system.

SUMMARY

We monitored the timing of migration and condition of smolts leaving Idaho during the spring of 1983. Hatcheries supplemented wild stocks with million chinook and 3.2 million steelhead smolts. Various Idaho Fish and Game personnel assessed smolt condition at hatcheries and release sites and project personnel further assessed condition as well as documented smolt passage at two migrant traps near Whitebird on the lower Salmon River and at the head of Lower Granite Reservoir.

Classical descaling, where two or more of the five scaled areas on one side of a fish are missing at least 40% of their scales, was generally low at hatcheries. Only in two samples each of 16 chinook and 19 steelhead samples did descaling exceed 1.0%. Scattered descaling, where at least 10% of scales are missing in a scattered fashion from one side of a fish, was high in samples where classical descaling was highest, i.e., Dworshak National Fish Hatchery chinook reared at elevated temperatures of 8°C and 12°C had classical descaling of 2.5-7.4% and scattered descaling of 19.0-22.1%, and Dworshak National Fish Hatchery steelhead from six raceways of their System 3 had 3.0% classical descaling and 49.3% scattered descaling. There was little difference in condition between samples taken at hatcheries and later at release sites. The only significant deterioration in condition observed was for Hagerman National Fish Hatchery fall chinook sampled at the hatchery and at the transport truck at Clarkston, Washington one hour prior to their release near the mouth of the Grande Ronde River. Classical descaling increased from 0.0% to 1.5% and scattered descaling went from 0.7% to 29.1%.

There were 86,146 chinook and 2,370 steelhead smolts captured and 17,094 chinook and 2,130 steelhead smolts were branded at the Whitebird scoop trap. We observed 466 chinook and 9 steelhead which had been branded at hatcheries. We estimate that the trap caught 0.32%, 1.20%, 1.18% and 2.04% of branded chinook released at Decker Flats, South Fork Salmon River and Pahsimeroi River, respectively. Small catch of steelhead smolts is probably a result from their tendency to migrate during high discharge-low trapping efficiency periods and their avoidance of entrapment due to the swimming speed of steelhead and a tendency to migrate deeper than the trap entrance. Data from the National Marine Fisheries Service indicated that 57% of chinook and 40% of steelhead smolts branded at Whitebird passed Lower Granite Dam.

The Red Wolf dipper trap caught 3,019 chinook, 379 steelhead and 38 sockeye. Only 35 branded chinook and 2 branded steelhead were observed. Objectives of the Red Wolf trap were unattainable due to insufficient catch. Trap location, which is thought to be the source of the problem, will be changed in 1984.

Median migration rate from release site to Whitebird for chinook ranged from 4.4 miles/day to 10.7 miles/day for chinook released at Rapid River and Decker Flats, respectively. Changes in river velocity and transparency strongly influenced migration rate.

By incorporating National Marine. Fisheries Service data on Lower Granite Reservoir travel time with our data, we were able to indirectly calculate travel time from Whitebird to Red Wolf. Chinook migration rates ranged from 7 to 35 miles/day. Day length and Salmon River temperatures were the most influencial variables in determining migration rate. Median arrival time at Lower Granite Reservoir ranged from April 18 to May 4 for the four Salmon River hatchery branded chinook groups.

In the Clearwater River, Kooskia National Fish Hatchery chinook migrated to Lower Granite Reservoir at 5.4 miles/day. Chinook released at Dworshak National Fish Hatchery traveled slower, at 2.5 miles/day, while migration rates for Dworshak steelhead ranged from 3.7 to 22.0 miles/day.

Descaling rate for chinook at Whitebird was less than 2% until late May and near 4% from then until the last week of trapping. Wild and hatchery steelhead had weekly descaling rates at 1-5% and 0-30%, respectively. Elevated descaling may be associated with hatchery rearing or transport of smolts. At Red Wolf, descaling of hatchery steelhead was generally less than 7%. Difference in descaling rate of hatchery steelhead between Whitebird and Red Wolf traps indicates that either catch of hatchery steelhead at Red Wolf was in large part composed of Dworshak steelhead which had low descaling rates, or (2) a large percent of descaled hatchery steelhead, as observed at Whitebird, died before reaching Red Wolf.

Larger smolts generally suffered higher descaling rates at Whitebird with rates of 10-15% of chinook larger than 160 mm, 8-15% of wild steelhead and 20-35% of hatchery steelhead larger than 200 mm. Since the highest descaling rates occur on large hatchery steelhead, it is possible that they are more easily damaged by procedures they must undergo at hatcheries.

A significant percentage of sampled smolts had only a single area descaled, not enough to classify a fish as descaled. Also, in some cases, many more than two areas were descaled. In order to depict the relative intensity of scale loss, Figures (19 through 24) are presented. At Whitebird the percent of chinook smolts with at least one area descaled increased as the season progressed from 2% in mid-March to 25% in late May. Hatchery steelhead with only one area descaled ranged from 6-16% weekly. Those with at least one area descaled, some of which had eight and nine areas descaled, ranged between 20-45% weekly.

Approximately 20% and 5% of steelhead and chinook, respectively, at Whitebird were wild. We used fin erosion for wild vs. hatchery identification of steelhead and length frequency distributions_, both historical (mostly wild) and present day for chinook identification.

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